World War II River Assault Tactics

GORDON L. ROTTMAN

ILLUSTRATED BY PETER DENNIS

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Series editor Martin Windrow

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feet to meters	multiply feet by 0.3048
yards to meters	multiply yards by 0.9144
miles to kilometers	multiply miles by 1.6093
pounds to kilograms	multiply pounds by 0.4536

ABBREVIATIONS USED IN THIS TEXT:

AA	antiaircraft
AT	antitank
CP	command post
hp	horsepower
mph	miles per hour
OP	observation post

GLOSSARY OF ENGLISH/GERMAN TERMINOLOGY

barge	*Lastkahn*
boat	*Boot*
- powerboat	*Motorboot* (*M-Boot*)
- assault boat	*Sturmboot* (*Stubo*)
- inflatable boat	*Schlauchboot*
bridge	*Brücke*
bridgehead	*Brückenkopf*
canal	*Kanal* or *Dole*
culvert	*Durchlass*
current	*Strömung*
ditch	*Graben*
downriver/stream	*Fluss-/Stromabwärts*
ferry	*Fähre*
ford	*Furt*
lake	*See*
pontoon	*Ponton*
river	*Fluss*
riverbank	*Flussufer*
river bottom	*Gewässersohle*
sandbar, shoal	*Sandbank*
stream	*Strom*
upriver/stream	*Fluss-/Stromaufwärts*

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WORLD WAR II RIVER ASSAULT TACTICS

INTRODUCTION

The assault crossing of a defended river line was one of the most difficult tactical offensive operations conducted in World War II. Regardless of the scope of the operation – divisional, corps, or army-level – the initial assault crossing was very much a tactical operation. Usually no more than a reinforced battalion or regiment, supported by considerable artillery, was committed to conduct the actual assault and to establish a foothold on the far bank. This initial assault was usually made by means of small man-paddled or powered assault boats. Once this was accomplished, follow-on forces would be shoved across as rapidly as possible to clear and secure a bridgehead; footbridges, ferries, and rafts were used for this phase, while larger pontoon bridges were being hurriedly emplaced for heavier traffic to cross. The troops landed on the far bank had to be prepared to meet immediate heavy counterattacks, and to hold the bridgehead until sufficient breakout forces were in place.

Vernon, France, August 25, 1944: British infantrymen of the 4th Battalion, Wiltshire Regiment, 43rd (Wessex) Infantry Division, hurrying to embark in a folding assault boat for the crossing of the Seine, under cover of the early-morning river mist. (IWM BU 71)

In the European theater, an army on the offensive could expect to encounter a water obstacle 75–100 yards wide every 25–45 miles; one 200 yards wide every 100 miles; and a river 300-plus yards wide every 200 miles. In between these were dozens of "gap obstacles" – streams, irrigation and drainage channels, gullies, smaller rivers, and canals; despite their comparatively small size these offered their own challenges, and it required considerable resources to get troops, vehicles, and heavy weapons across them, even if their beds were dry. At the other end of the spectrum, armies attacking on wide fronts needed to emplace numerous bridges – several per frontline division, plus many others maintained on the lines of communications.

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The tactical doctrine for river assault-crossings, the equipment provided for the assault and for the subsequent creation of bridgeheads, and the capabilities of the troops, were surprisingly similar between the main belligerent armies in World War II, whether US, British Commonwealth, Soviet, or German. All achieved successes when all the required elements were combined: adequate intelligence, effective tactical planning, realistic consideration of terrain and weather, reasonable assessment of the defenders' capabilities, effective coordination between the involved units, and the timely marshaling of crossing and bridging equipment. When success was achieved, it might bring not only operational but even strategic advantage; but when the preparation and coordination proved insufficient, the costs could be shocking.

Red Army Lend-Lease 2½-ton trucks being driven along a partly submerged plank road over the shore of a river widely flooded by the spring thaw. Russia's infamous *rasputitsa* – the season of almost impassable mud – also returned during the prolonged fall rains each year. (From the fonds of the RGAKFD in Krasnogorsk via Stavka)

The anatomy of a river

Rivers rise in mountains and hills, and their headwaters are fed by rain, snowmelt, springs, and the runoff from boggy ground. Areas are drained by small creeks; these link into larger streams, and then into the tributaries of rivers. (Owing to the vagueness of languages, there are no common definitions by size of exactly what constitutes a creek, a stream, or a river.)

The river is contained within its banks, but these are temporary, in that seasonal rain and snowmelt can cause it to overflow and flood. Rivers generally flow down valleys between higher ground, and these may be anything from relatively narrow canyons to broad alluvial corridors. On rocky terrain rivers may be contained in deep, steep-sided gorges; broader valleys are typically floored with alluvial deposits, the rich soil creating bottomlands excellent for agriculture. Lakes can form naturally at places along the river's course, depending on the lay of the land, but many lakes are man-made, with dams providing reservoirs for human use.

As rivers continue their journey to the sea their nature and geography change drastically. As they flow through the containment of narrow highland gorges and down steep gradients they can be rushing torrents; rocks and gravel are carried down the gorge and ground up, creating sediment. Further downstream, where the current is slowing, the introduction of decaying vegetation and eroded topsoil also creates softer silt. Any given riverbed can progress unevenly, depending on the materials introduced. Governed by the lay of the land, rivers can run relatively straight, meander in gentle curves and bends, or make drastic turns and loops. Where the water moves slower around the inside of a loop a sandbar or shoal of sediment may accumulate, while the bank on the faster outer edge of the loop is cut away by a deep channel.

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Red Army sappers prepare to row a pontoon section out to be joined to the end of a light floating bridge; note the length of the oars. The deck section rests on two 23ft-long NLP folding pontoon boats; with a third boat in the center, the deck could also be used as a raft. The profile of a river's banks was as critical as its width and speed when choosing a crossing site; when this bridge reaches the far side the engineers will have to cut an exit ramp through the steep bank with hand tools before vehicles and heavy weapons can cross. (Nik Cornish at www.Stavka.org.uk)

Rivers have always attracted human habitation, and they and their valleys provide natural routes for both commerce and military movements. Roads, highways, and railroads may parallel the river closely or some distance away, sometimes on embankments built high enough to avoid flooding. Tributaries, streams, and man-made canals for irrigation or water traffic may also contribute to creating a complex landscape on the valley floor, with rural fords and ferries where they intersect land routes. Villages, towns, and cities will be found at frequent intervals along rivers, and the larger ones may straddle the river, possessing one or more bridges for road and rail traffic. All these factors are central to the planning of military movements.

Terms of orientation for rivers must be understood. In this text the "near" bank (shore) is that on which the attacking force is situated, the side they are attacking from; the "far" bank is the enemy's side, the attackers' objective. (Of course, defenders will refer to the banks *vice versa*.) "Downstream" is the direction in which the water flows, eventually to the sea; "upstream" is against the current. In Europe the terms "left" and "right" bank are often used, these being in relation to an observer facing downstream. These are used instead of cardinal directions, to prevent confusion. A river often twists and turns; its general trace might be from north to south, but to refer to the far side as, for instance, "east" might be misleading, because turns could place a unit on the south side of a loop even though technically it would still be on the west side of the river.

Bridges span streams, canals, rivers, lakes, etc; "culverts" are smaller bridges typically crossing a narrow creek or ditch. They range from a buried drainage pipe to a small single-span bridge, and in US terminology a culvert is considered to be 20ft long or less.

Rivers as military obstacles

The form of riverbanks is critical to river-crossing operations. Banks may be virtually level with the water, or rise anything from a few feet to many feet above normal water level. Their profile below the water may drop off steeply, slope gently, or be of any degree between. The banks may rise abruptly, directly out of the water, or be some distance back from its edge, and the slope and composition of the shore between the water's edge and the bank

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are also important. Is the surface gravel, mud, sand, or a deceptive layer of gravel over soft mud? Will it support the weight of vehicles, or even infantry? One or both sides of the river may be boggy or marshy, and vegetation – reeds, brush, or trees – may pose obstacles.

More often than not the opposite banks of a river are very different. One may be dry and firm and the other boggy and impassable, at least for a short distance inland from the water's edge. Often one shore will be relatively flat and initially rise little above river level, while the opposite shore may be faced with higher banks, bluffs, or hills (a situation beneficial to the defender if the high ground is on his side of the river). One or both banks may have man-made levees or stone bulkheading to contain the river during flood seasons.

Depth and bottom composition may not be an issue if the river is to be crossed by boats, landing craft, amphibious vehicles, ferries, or floating bridges, but they are crucial to any attempt simply to cross by fording. A shallow river may not necessarily be fordable by vehicles or troops owing to deep mud or soft sand, rocks, rubble, or snagged logs and stumps. While most of a river's width may be fordable, there is often a narrow but deep channel near one of the banks that will prevent fording. Fords may be natural where bottom composition, depth, and current speed are suitable, or man-made with improved approaches, exits, and stone-paved bottoms. Sometimes fords or low-water crossings were found beside bridges over streams and small rivers, and could be used if the bridge had been destroyed and seasonal water levels were low.

The depth and speed of a given river are far from consistent, varying considerably according to season and weather, and they can change in a matter of hours. In summertime streams, drainage ditches, and even smaller rivers may be dry or may carry only a trickle of water. They can usually be crossed easily, but steep banks, a deep main channel (even if dry), and bottom obstructions may require prior work. Fall rains can swell water obstacles considerably and, coupled with mud, this creates serious barriers. Significant rains may also be encountered even in summer, especially near coastal areas as ocean storms come ashore. Spring rains and snowmelt raise the level of streams, rivers, and lakes most dramatically, and may produce widespread flooding over areas far beyond their normal banks – the "floodplain."

Crossing frozen rivers

On much of the German/Soviet *Ostfront* both sides had to calculate the practicalities of getting vehicles and troops across frozen rivers and lakes in winter. The thickness and condition of ice varies, and with them its load-bearing strength. Even if vehicles can cross it initially, heavy traffic may weaken it, as does thawing and refreezing. Ice in contact with the water supports heavier weights; if the water level drops, creating an air space between ice and water, the ice's load-bearing capability is reduced. Clear, freshly frozen ice is stronger than old, white, porous ice, and warmer weather quickly reduces the carrying capacity even though the thickness remains the same. Newly frozen, clear ice in contact with water can bear the following loads:

1.5in	Individual soldiers
2in	Infantry in open order
4in	Single horses
6in	Infantry and cavalry in march column with light motor transport
8in	Light artillery up to 2.5 tons, horse-drawn, and 4-ton wheeled vehicles, maximum axle load 2.7 tons, with minimum 65ft interval between vehicles
12in	l0-ton wheeled vehicles, maximum axle load 7 tons, minimum 65ft intervals
14in	20-ton wheeled vehicles, minimum 100ft intervals
18in	Light and medium tanks, minimum 100ft intervals

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The Roer river at Jülich, Germany, in February 1945; the town was almost entirely ruined by bombing, artillery, and flooding owing to the destruction of a dam. At center is an M2 treadway bridge; just visible flanking it some way up and down stream are M1938 infantry footbridges. Emplacing these both protected a main bridge from debris flowing downstream, and kept the main bridge clear for urgent heavy traffic. (Tom Laemlein/Armor Plate Press)

The increased volume and faster flow of water in such seasons has great impact on the use of small boats, ferries, and floating bridges, and may make their employment impossible, since most pontoon bridges cannot withstand more than a few knots' river speed. Flooding over adjacent areas will further hamper operations, making roads and low ground impassable and unusable for military facilities. Another hazard during flooding is the masses of bridge-wrecking debris washed downstream, ranging up to complete treetrunks.

A tidal river is the stretch approaching the seacoast in which the flow and depth can be affected by ocean tides and storm surge. In such cases it is common for the flow to be controlled with locks and sluices upstream, and parallel watercourses may be connected by canals. The defenders' control of these facilities allowed the increased release of water to hamper operations and even prevent crossings by the attackers. When the British 46th Division attempted to cross the lower Garigliano river in Italy in January 1944, they were completely frustrated by the Germans releasing water from the Liri, turning the Garigliano narrows into an impassable torrent. Conversely, in Normandy that summer the US 35th Infantry Division was advised by a local French engineer on how to manipulate locks on the Vire river. The American engineers opened the lock to lower the water level when a crossing was desired, and closed it to protect the division's flank. They discovered a German underwater bridge further downstream, and closed the locks one night to raise the water by 7ft, reportedly drowning German troops and horse-drawn artillery.

A TYPES OF TACTICAL BRIDGE

The tactical bridges employed by the different belligerent armies were very similar in conception:

(1) US M1938 infantry footbridge

This was widely used; it was common to erect one upstream from larger pontoon bridges – not only to take foot traffic off the latter, which were urgently needed for vehicles, but also to screen the larger bridge from floating debris. The 10ft x 1ft x 1ft floats were simple plywood boxes filled with cork, here weighted at the downstream ends with sandbags to keep the upstream ends from being forced under by the current. Each set came with 432ft of 26in-wide duckboards, and could be erected in 30 minutes. Assault boats could be substituted for the floats; a similar bridge for light vehicles could be built using pairs of assault boats connected end to end, the pairs secured 10ft apart at the centerline, with dual plywood treadways laid across them.

(2) US fixed treadway bridge (from above and side)

The steel treadways and trestle supports of the M1 and M2 pontoon bridges (see Plate F) could also be erected as a fixed bridge over shallower waterways.

(3) British folding-boat bridge

This employs steel trestles at the ends, pairs of 21ft 9in-long Mk III folding boats as pontoons, and clamped-together wooden deck panels with steel longitudinal bracing. It could be erected quickly, and supported an 8-ton load.

(4) Russian TZ-1 "unsinkable" footbridge

Similar to the US M1938 bridge at (1) above, this could be erected as a single 184ft-long lane or a 92ft double lane. The floats were waterproofed canvas cases holding kapok or other buoyant material; the duckboards were 2ft 4in wide and came in 11ft 4.8in sections, with a pair of the floats under each end. A duckboard section on four floats could be used as a small raft, and would support an entire squad; any reasonable number of floats could also be lashed together and used as a raft even without decking. A similar type of footbridge could be assembled using duckboards and 10ft 6in LMN three-man inflatable boats.

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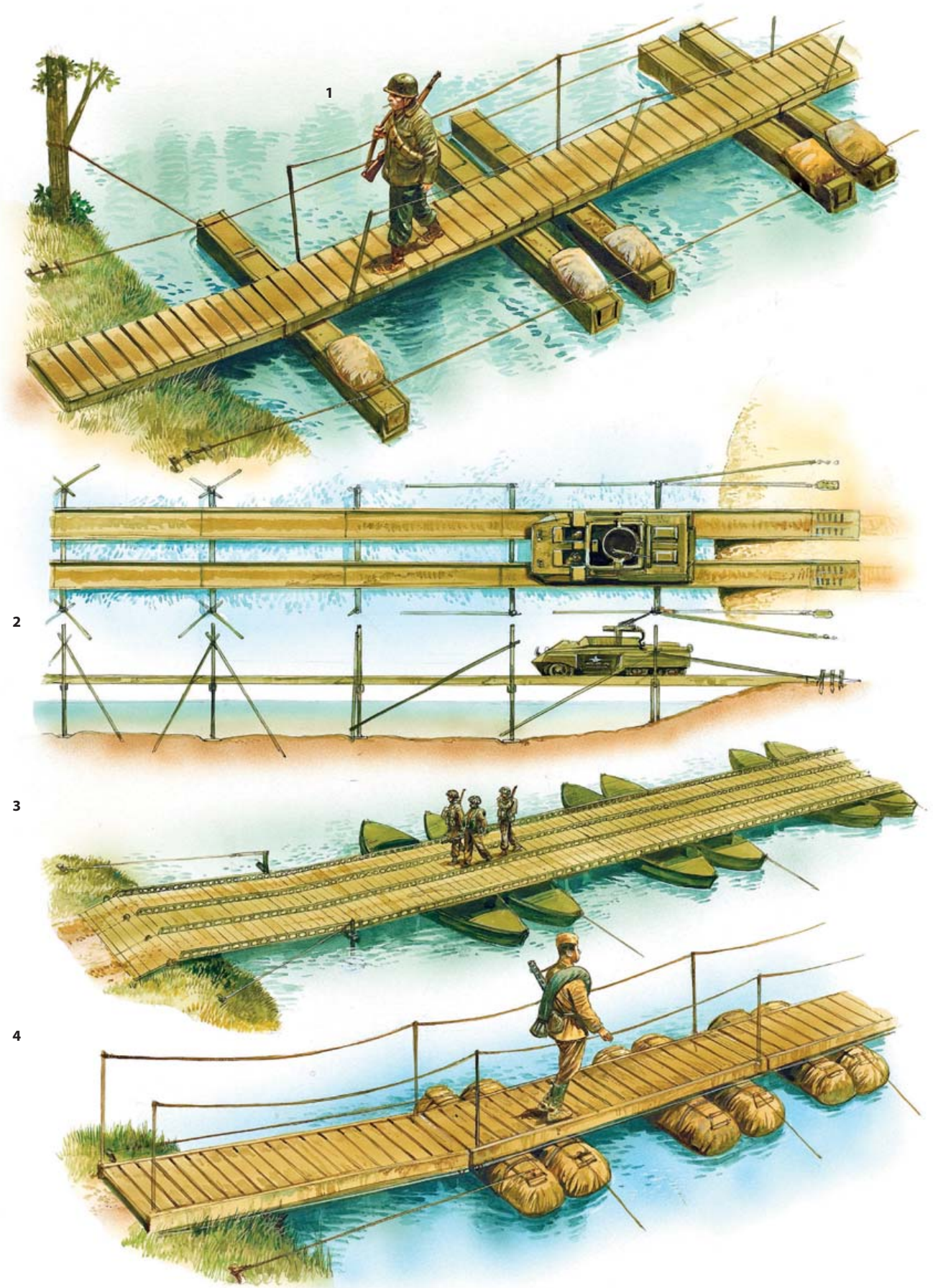

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Red Army infantrymen using the PBC swimming suit (see Plate C6) to make their way along and into the reeds on a lake shore. The PBC would support a man in full combat equipment, but these scouts have left their backpacks behind. (Nik Cornish at www.Stavka.org.uk)

IMPROVISED MEANS OF CROSSING

Expedient means of crossing streams and rivers were useful for small units or patrols, which might cross by night or in other limited visibility to reconnoiter, clear obstacles, or gain toeholds. However, they did not allow enough troops and material to get across to be of much benefit in a major assault.

If **wading** a stream, soldiers often removed their boots, and in cold weather their trousers and other clothing if the water was deep. Wading even a shallow stream could be tricky; a 6in-deep stream moving at a few miles per hour could sweep an unwary or unbalanced man off his feet. Stretching a rope across was a great help, as was a walking stick carried on the downstream side to brace oneself against the current.

Current speed was important, as **swimming** soldiers can only make about one half-mile per hour (less, if using a flotation device and/or carrying equipment), so a 3mph current would carry a soldier a considerable distance downstream. Regardless of the type of flotation gear used, the soldier will invariably be soaked through; this reduces combat efficiency, and in cold weather can be debilitating. Prolonged exposure to water even at a warm temperature of 26°C (79°F) can cause hypothermia (severe lowering of core body temperature), and immersion in water at 10°C (50°F) can cause death in one hour.

It is virtually impossible for a soldier to swim in a waterlogged uniform and weighed down with boots, belt kit, ammunition pouches, canteen, rations, entrenching tool, bayonet, helmet, rifle, and other equipment; this load would weigh almost 40lb even when dry, and a great deal more when wet. It is therefore necessary to improvise some means of increasing a man's buoyancy, or, ideally, floating his gear across separately. An ancient **flotation device** was the brushwood bundle, a 1–3ft diameter bundle of limbs and branches 3–5ft long and tied tightly with cord or wire. Even a small one

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Only for the most sure-footed: Waffen-SS infantrymen make their way across a crude birch-pole bridge, as commonly built over streams by Russian peasants. With the trestles hammered deep into the streambed, this was quite a sound structure – although this particular example needs more poles on the footway. (Private collection)

would keep a man afloat, and tightly wrapping the bundle in waterproof canvas (such as a shelter-half or rain cape) made it even more buoyant. Crude log and timber rafts could also be fabricated, but often uncured logs were too full of sap to provide enough buoyancy, and might simply sink. Kapok life vests were sometimes used, but many types could not adequately support a combat-loaded soldier. The US issued the M1926 tubular inflatable lifebelt that wrapped around the torso, but this did not keep a man upright in the water, and a second one had to be worn for it to be effective.

The US Army prescribed a two-man **"rifle float"** that could be prepared in 7 minutes. Two shelter-halves were spread on the ground one on top of the other, and the two packs and removed clothing were placed on them. The rifles were crossed to provide rigidity and placed on top of the packs and clothing. The four corners of the outside shelter-half were tied to the muzzles and butts with the shelter-half ropes. In a similar manner, two 3ft sticks or two shelter-half poles could be used instead of rifles for floating a light machine gun, 60mm mortar, or two BARs.

Empty oil cans, 55gal (200 liter) fuel drums, the 5gal (20 liter) fuel and water cans ("jerry cans") used by most belligerents, or any other sealable containers would provide a man sufficient buoyancy. Though less effective, vehicle tire inner tubes were also used. Roping together numerous containers or fastening them to a wooden framework provided usable **rafts**. Most armies produced plans for wood-frame affairs supported by fuel drums that could carry a substantial load. The Russians used a raft made from three pairs of 8ft-long 2in x 8in planks with four fuel drums wired crossways under each pair. The three sets of drums and planks were set with 1ft between them, and then an 8ft plank was fastened across each end of the raft. This could carry two dozen troops or, if decked over, an antitank gun and crew.

The US Army developed a technique in which a jeep was driven onto a spread 12ft x 17ft canvas tarp or the 12ft x 13ft 6in canvas cover from a

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1943: British Commandos under training cross a "toggle bridge" under simulated artillery fire at the Achnacarry training center in Scotland. This is a three-rope bridge, with individual "toggle ropes" used as V-shaped spreaders; a two-rope bridge, with one long rope above another joined by vertical spreaders, was actually more stable than this three-rope type. (IWM H26620)

2½-ton truck, the sides being folded up and secured by rope (naturally, any holes and rips needed to be patched). The canvas-wrapped 3,300lb jeep would actually float, and could be towed by a boat. The jeep's ¼-ton trailer was watertight and would float with a full load; two men could even (awkwardly) paddle an empty trailer across a slow-moving river.

Rope bridges could be erected quickly, and had the great advantage of keeping troops dry (although, of course, someone had to swim the ropes across first and secure them). A one-rope bridge required a man to make an inverted crawl hanging underneath the rope, which was quite tiring with equipment; no matter how taut the rope was, the last one-third was still "uphill." A two-rope bridge consisted of one rope 4–6ft above the second, the two being connected at intervals by short "spreader" ropes. This allowed a man to sidestep across, and was fairly stable. The three-rope bridge had a lower rope to walk along and two higher hand-ropes connected to it at intervals by spreader ropes forming a "V" arrangement; this required the most time to construct. British Commandos and Airborne troops and US Rangers were often issued "toggle ropes." These were 6–8ft lengths of rope with a braided loop in one end and a crossways wooden toggle-handle at the other; the toggle could be slipped through the loop of a second rope, and thus any number could be connected end to end.

Germany, 1945: US infantry squad with a 60mm M2 mortar piling out of a plywood M2 assault boat. Masking this in the foreground is one of the 18ft utility powerboats used for bridge erection and pushing rafts. (Tom Laemlein/Armor Plate Press)

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Carrying about 18 troops each, *mitte Schlauchboote* (medium inflatable boats) ferry infantry across a Russian river; two boats could carry a rifle platoon. In the distance, the engineer crew take an emptied boat back for the next load. (Private collection)

ENGINEER BOATS

The engineer branches of all armies employed small boats for reconnaissance, delivery of troops and equipment, towing or pushing rafts and ferries, assisting in bridge erection, and utility and courier work. They were usually organic to the units that used them, but in some cases they were centralized for allocation to units as needed.

Assault boats were generally of all-wood construction (planks or plywood sheet), small and relatively lightweight, since their passengers needed to be able to carry them to the water's edge, and they were less vulnerable to small-arms fire than inflatable boats. Most lacked seats, so as to provide maximum passenger and cargo space. Rope lifelines attached around the sides could double as carrying handles. Outboard motors were available but only in small numbers, and were reserved for special use (an exception was the German *Sturmboot* with an integral motor). The common means of propulsion was paddles wielded by the passengers; sometimes boats were delivered without paddles, and troops had to improvise using poles, boards, and rifles. Besides a helmsman steering the boat, one or two engineer paddlers had to be provided to return the boat to the near shore, though in some instances the first-wave boats were simply abandoned to be recovered later.

Paddle-powered boats typically made 3mph, so even a 3mph current could be too much to handle; currents might take a boat far downstream before reaching the far bank, and wind also had an effect on drift. This drift factor – often considerable on a wide, fast river – was figured into the assault plan. The consequent delay in arrival on the far bank obviously exposed boats to more enemy gunfire. For rivers less than 200ft wide, ropes or cables could be stretched across after the assault phase and thereafter boat passengers could pull themselves over. In other instances ropes were attached to both ends of a boat, and troops on both shores (and eventually, ferried-over trucks) would pull it back and forth.

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Folding boats or collapsible boats were often used in the assault role. The British called this craft an FBE – "folding boat equipment" – or sometimes a "fol-boat." Their advantage was that they could be collapsed flat to allow more to be stacked on trucks. They were of two types: with either waterproofed canvas sides, or plywood sides and stern transoms with full-length canvas "hinges." All had wooden bottoms, and were erected by unfolding internal braces, with cross-stays to maintain their shape.

While these were usually paddle-propelled, self-propelled utility boats were used during bridge erection to push pontoon sections into place, to assist with repairs, tow or push rafts, serve as couriers, and for general work. They could also deliver assault troops, and were generally larger and faster than most self-propelled assault boots.

Inflatable or pneumatic boats, also known simply as "rubber boats," saw widespread use. They were usually made of black rubber but might be painted a more subdued color; others were made of olive-drab canvas coated inside with either rubber or a synthetic sealant. Boats had multiple cells, each of which had to be inflated individually; even with most of the cells penetrated the boat would maintain some degree of buoyancy. Small boats could be

Assault boat characteristics

US	Crew/passengers or cargo capacity	Length	Beam	Height	Weight
M1	2/9	13ft 6in	5ft 11in	2ft 1in	200lb
M2	3/12	13ft 5in	5ft 11in	2ft 1in	410lb
M3 Storm	2/7 or 1,880lb	16ft 9½in	6ft 6in	1ft 10in	440lb
Utility*	2/10 or 4,000lb	18ft	6ft 7in	3ft 2½in	1,800lb
British					
Assault Mk I	2/7	12ft 1in	4ft 8½in	1ft 11in	174lb
Assault Mk II	2/7	12ft 1n	4ft 8½in	1ft 6in	162lb
Assault Mk III	2/16	16ft 11in	5ft 6in	(-)	350lb
Storm Mk I	2/18 or 3,500lb	20ft	6ft 7in	(-)	1,500lb
German					
l.Stubo.39	2/6	19ft 7in	5ft 2½in	3ft	441lb
s.Stubo.42	3/up to 40	47ft 7in	9ft 9½in	(-)	20,944lb
M-boot 41*	2/6 or 3,400lb	23ft	6ft 8½in	(-)	4,000lb

* The US utility boat and German Motorboot were used for bridge erection, propelling rafts, and other tasks, but could also deliver troops in the post-assault phase.
(-) = information not available

Folding boat characteristics
These boats could be used for assaults, reconnaissance, bridge pontoons, and small ferries.

British	Crew/passengers or cargo capacity	Length	Beam	Height	Weight
FBE Mk III*	5/16 or 2,750lb	21ft 11in	6ft 8½in	2ft 11in	940lb
Soviet					
MSL	1/4 or 800lb	11ft	3ft 11in	1ft 4in	132lb
DL	2–4/10–12 or 3,000lb	18ft	4ft 11in	1ft 8½in	375lb
NLP	5–9†/10,000lb	23ft	6ft	2ft 8½in	900lb

* The earlier Mk II folding boat equipment (FBE) had similar characteristics.
† Paddle-propelled; crew of two when with outboard motor.

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inflated by mouth, but larger ones were provided with hand- or foot-operated pumps, and air compressors could also be used where available. Repair kits were provided, along with wooden bullet-hole plugs.

Pneumatic boats were surprisingly buoyant and could carry heavy loads for their size. Even small inflatables were used for pontoon bridges and ferries. With "saddle" adapters allowing treadway sections to be laid across them, a number could be used as the basis for a ferry capable of carrying a small vehicle or AT gun. Most were paddle-propelled, but some had a wooden transom to allow an outboard motor to be mounted.

Commandeered civilian boats and ferries, of any kind from skiffs and punts to large fishing boats, would also reinforce the crossing effort. Of course, a withdrawing force would destroy any of these craft that they left behind.

German engineers have made an infantry footbridge across a narrow river in a town by lashing 18ft medium inflatable boats to the girders of a fallen bridge, and connecting them with doubled planks tied down to the boats' fittings. (Private collection)

American M2 assault boat

The M2 assault boat or "plywood boat" was widely used, and sometimes also supplied to British Commonwealth units. As an assault boat it mainly delivered the lead elements during river crossings. This was a scow-type craft with a blunt, squared bow, a flat, squared, vertical stern, and a flat bottom slightly up-curved at the chin. There were no seats. Two hinge-like fittings allowed two boats to be coupled stern to stern and the hinges locked with a retaining pin. This allowed the paired boats (26ft 11in long, displacing 8,000lb) to be used as pontoons for the infantry-support raft and the expedient assault-boat bridge. Paired spacer slots for plywood treadways were located in each gunwale.

Nine paddles were provided, four each side for kneeling passengers and one for steering. The crew was three trained combat engineers: one steered, the others were the forward paddlers who assisted passengers when loading and unloading, and paddled the empty boat for its return. Seven nested boats were transported close to the crossing site on a two-wheel trailer or a 2½-ton truck; 10 could be so transported for short distances on level roads. It required 4–6 men on each side to carry the 410lb boat to the water's edge, with two engineers carrying and distributing the paddles and the steersman following to direct the launching. It was carried inverted to the final concealment before the water's edge, then turned over, carried upright to the water's edge, and launched. A small outboard motor could be mounted, but was seldom available. Fully loaded the boat had an 8in freeboard, so it could not handle rough water. In addition to the three-man crew an assault boat

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Moselle river, French-German border, 1945: the "scow" shape of the M2 assault boat is clearly seen in the foreground. Beyond it, a jeep, trailer, and 20-plus troops are ferried across on an infantry-support raft. This consists of three paired assault boats and two parallel plywood treadways; each of the latter is composed of three 14ft-long sections, 3ft 1in wide and with a 2ft 6in gap between them. This ferry is propelled by a 50hp Evinrude outboard on the center boat, and another is carried as a spare in case of breakdown. Several of these rafts could be linked together to make an infantry-support bridge. (Tom Laemlein/Armor Plate Press)

could carry:

A 12-man rifle squad with full equipment.

Two light machine-gun squads of 10 men, 2 air-cooled guns, and 20 ammunition boxes.

One heavy machine-gun squad of 7 men, 1 water-cooled gun, and 13 ammunition boxes.

Two 60mm mortar squads of 10 men, 2 mortars, and 72 rounds.

One 81mm mortar squad of 7 men, 1 mortar, and 50 rounds.

Communication platoon wire section of 8 men, with complete equipment.

Two assault boats coupled together could carry a 37mm AT gun with 5 men and 100 rounds. Only a 3-man crew was needed for the double-boat.

The US also used a 19ft-long, 3,100lb bridge-erection boat with a 92hp engine giving it an 18mph speed. The 27ft-long, 6,325lb bridge-erection boat was transported in two sections, with two 92hp engines for a speed of 18mph.

B

ASSAULT BOATS

All armies possessed several models, to include skiffs, collapsible/folding canvas and wooden boats, sheet-metal stacking boats, and powerboats. The silhouette figure, for scale, represents an average soldier 5ft 8in (1.72m) tall.

(1) US M2 assault boat, with paddle

This rigid wooden scow, with a flat prow and stern, was 13ft 5in long x 5ft 11in wide x 2ft 1in high; it could carry a crew of three and up to 12 passengers. Two boats could be fastened end to end for use as a pontoon float. Note the handgrip slots in the protruding gunwale; the cutaway shows the inside bottom decking.

(2) British FBE Mk II assault boat, with paddle

A collapsible wood-and-canvas boat with metal bracing struts; 12ft 1in long x 4ft 8½in wide x 1ft 6in high, this took a crew of two and up to seven passengers (four paddles were provided); it weighed 162lb. The cutaway shows a black rubber floor pad.

(3) Russian DL-10 landing boat, with oar

With two sections joined centrally, this was 18ft long x 4ft 11in wide x 1ft 8½in high, and carried two to four crewmen and 10 to 12 passengers. It was a folding design made of plywood coated with Bakelite, with riveted metal edge strips and diagonal metal bracing struts. There was a small seat inside each flat canvas end panel. It was provided with 5ft oars, and was unusual in having bench seats for rowers – most armies considered that these took up too much space. Oarlocks (rowlocks) could be slotted into the gunwales above the four seats.

(4) German *leicht Sturmboot 39*, with "powered oar"

The 1939 light assault boat was of rigid wooden construction, 19ft 7in long x 5ft 2½in wide x 3ft high. Despite its relatively large size it still only accommodated two crewmen and six passengers; the outboard "powered oar" (sectioned here to fit on the page) was 13ft 4in long, and the engine and fuel tank took up a lot of space and weight capacity. Later versions were partly decked over to improve seaworthiness.

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Engineers help troops of the 90th Inf Div get settled in an M2 assault boat on the bank of the Moselle river. Note the hinge-like fittings and rods on the edges of the stern transom; these allowed two boats to be fitted together end to end when they were used as pontoons. The SCR-300 "walkie-talkie" radio identifies this as a company headquarters command group. Their backpacks will be brought across later by the company train, so they have hastily lashed their day's K-rations to their web gear with cord. (Tom Laemlein/Armor Plate Press)

British folding and rigid boats

One of the most widely used was the Mk I, adopted in 1928. It was a collapsible boat with a plywood bottom, cedar-slat floor, canvas sides, and a rigid wooden gunwale, and when collapsed it lay only 4in high. The Mk II, developed in the mid-1930s, had a nonskid rubber floor pad instead of the slats, which helped reduce noise when loading, and slightly lower sides (the interim Mk IA had a similar rubber pad). The Mk I had two locking struts on each side and one in the bow, while the Mk II had three on each side and two in the bow. The stern transom was plywood.

January 1944: British infantry cross an Italian river using Mk III folding assault boats, also known as Goatleys. Note the wooden-slat decking, and the support braces in the canvas sides. These craft were painted quite a vivid pea-green – see Plate B2. (IWM NA 10860)

Five paddles were typically issued with the boat; it required at least two crewmen paddling, and two more were selected from the seven passengers. The section's Bren gun was typically positioned in the bow. Six men could carry the boat by gripping the gunwale rim. The boats could be used as pontoons for light bridges, and for rafts: with special fittings a 2-pdr AT gun could be carried, and a tracked Bren gun carrier could be carried by a pair of boats. (It was this type of boat, without motors, that was provided to the US 3rd Bn, 504th Parachute Inf Reg to cross the 400-yard wide Waal river 2km (1.2 miles) below the Nijmegen bridge in September 1944, in broad daylight. Only 11 of the 26 boats were able to make a second trip.)

The Mk III FBE of 1938, also known as the Goatley, was larger and pointed at both ends, allowing it to be paddled or rope-pulled back and forth without having to be turned around. It had a wooden bottom,

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Under the protection of a smokescreen, eight German soldiers directed by an engineer drag a *leicht Sturmboot 39* to the water's edge. Note the unique "powered oar" combining the 30hp engine, fuel tank, and long propeller shaft in one assembly; while bulky and extremely heavy, this gave the M1939 Light Assault Boat a speed of 16 knots. Assault boats were operated by ten 250-man *Kommando* units; each *leichte Sturmboot-Kommando* had 81x boats, in three platoons each of seven squads plus spares. In 1944/45 they were redesignated as light assault boat companies. (Private collection)

canvas sides with a wooden gunwale, and brackets to keep the canvas sides erect: four on each side, one in the bow and stern. Hand-ropes were fitted to the sides, and five paddles were issued. It could be used as a bridge pontoon for troops and light vehicles, up to Class 9. In 1944 Evinrude 50hp or Johnson 22hp outboard motors began to be provided to some units, thus reducing the boat crew to one; they proved temperamental, and were replaced with British Seagull 4hp motors.

The Mk I storm boat was a rigid, blunt-bowed skiff with side-mounted bench seats in the aft third; even with a full load it had a 12in freeboard. There was a motor mount on the stern for an Evinrude outboard. Three were transported nested in a lorry along with 12 treadway sections.

Pneumatic boat characteristics

US	Crew/passengers or cargo capacity	Length	Beam	Height	Weight
2-man recon	2–3	8ft	3ft 9½in	1ft 9½in	25lb
6-man recon	4–6	(-)	(-)	(-)	78lb
6-ton float	15–30	20ft	6ft	2ft	375lb
British					
recce	2	6ft 7in	2ft 7in	1ft 3in	40lb
Soviet					
LMN	1/5 or 1,400lb	10ft 6in	4ft	1ft 4in	95lb
LG-12	3/10–12 or 3,000lb	16ft 5in	5ft 3in	1ft 7in	176lb
A-3	10*/20 or 6,000lb	20ft	7ft 6in	2ft 9½in	900lb
DLP	5–9*/8–12 or 6,000lb	15ft	6ft 2½in	3ft	704lb
German					
klein 34	3 or 660lb	9ft 8½in	3ft 8½in	1ft 4in	116lb
mitte	7 plus 1.35 tons	18ft	6ft 1in	2ft 2½in	330lb
grosse	(-) plus 13.5 tons	26ft	9ft 8½in	(-)	637lb

* Paddle-propelled; crew of two with outboard motor.

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German *leicht Sturmboot 39*

The German "light assault boat 1939" was unique among this class. The 19ft 7in *l.Stubo.39* was of rigid wooden construction, with a pointed bow, a flat bottom with a curved bow chin, and a flat stern plate. What made this otherwise conventional design unique and highly effective was its engine, called a "powered oar." This consisted of the 4-cylinder 30hp engine, fuel tank, controls, and an 8ft 11in diagonal propeller shaft all contained in a single unit that was mounted on a pivot on the stern plate. Two handles allowed the standing helmsman to swing the engine's shaft to steer the highly maneuverable boat at up to 16 knots (though a drawback was that he had to stand upright and exposed). The propeller's depth could be varied, which was beneficial in shallow water. The downside was that the 13ft 4in-long, 412lb engine assembly (almost heavier than the boat itself) required at least five men to carry it, so at least eight men to carry the whole boat – more than it could carry on the water.

Rope lifelines ran most of the hull length and were used for carrying. The boat had a two-man crew and could carry six combat-equipped troops, with the machine gun belonging to the transported squad mounted on the bow. When the initial assault troops had secured the far shore, a medium or large inflatable boat could be lashed on either side of a *Stubo* to allow more troops to be delivered by one powerboat, albeit at a slower speed. The *Stubo*'s stern protruded aft of the inflatables to allow the powered oar a full traverse.

There were three versions of the *Stubo*. The original boats were completely open. A later *gedeckte* version had the forecastle and fantail (bow and stern portions) decked over to prevent water from sloshing over, with an MG mount forward on the right; these modifications added 165lb to the 441lb boat. A still later version was nicknamed the *schottenboot* ("Scottish boat," after a feature of small Scottish fishing skiffs); this was fitted with forward and aft bulkheads, to further reduce the amount of water shipped aboard and thus improve seaworthiness.

C

INFLATABLE BOATS

Inflatable or pneumatic boats were used by all armies for reconnaissance (2–3 man, as well as larger models); assault crossings; ferrying troops, weapons, and supplies; and as bridge and ferry pontoons. Most were made of vulcanized rubber, but smaller ones might be made of synthetically treated canvas. The former were mostly black or gray, while fabric types were olive drab; inflatables might be painted in more subdued colors, which inevitably peeled off sooner or later. Again, the silhouette for scale shows a soldier 5ft 8in tall.

(1) American reconnaissance boat, with paddle
This was 8ft long x 3ft 9½in wide x 1ft 9½in high. It carried 2 or 3 men – 2 was more practical if they had combat equipment. Its treated canvas tube contained 12 air cells, more than most inflatables; note the canvas flaps covering the air valves. Two boats were sometimes lashed side by side to more effectively carry 6 men. Each boat came with 2 paddles.

(2) British reconnaissance boat, with paddle
This rubberized canvas boat, also used by other Commonwealth forces, had only 2 air cells, 1 each side. It measured 6ft 7in long x 2ft 7in wide x 1ft 3in high; while 2 bench seats were provided, it only barely accommodated 2 men, with no space for equipment – a fact that caused complaints throughout the war.

(3) Russian LMN boat, with paddle, inflation tubes, and pump
Measuring 10ft 6in x 4ft x 1ft 4in, this could accommodate 6 cramped men, or 4 with a Maxim MG, or 635kg (1,400lb) of cargo. It was made from a single-cell rubberized canvas tube, and had a collapsible wooden-slat deck and 1 bench seat. Also illustrated are the slightly curved paddle, 2 inflation tubes, and the bellows-type foot pump as used by all armies.

(4) German *klein Schlauchboot 34*, with paddle
This measured 9ft 8½in x 3ft 8½in x 1ft 4in, and had a handling rope strung around the edge of the 2-cell tube. It could carry 3 men or a 300kg (660lb) load, and was provided with 3 paddles.

(5) German *mitte Schlauchboot*
This was almost twice as big, at 18ft x 6ft 1in x 2ft 2½in. It could carry a helmsman and 6 paddlers with 1.35 tons of cargo, but up to 18 men with light equipment could be crammed in. It used the same paddles as the small 1934 inflatable. The Russian A-3 (not illustrated) was virtually identical in appearance, but 20ft long; it could carry up to 20 troops, or 2,730kg (6,000lb) of cargo.

(6) Red Army soldier with PBC swimming gear
This consisted of a circular black rubber inflated tube with brown leather straps, chest-high waders, and 2 hand-paddles. It was practical for scouts and engineers, and in calm water a man could cover 100m (330ft) in 6 minutes. When not in use the inflated tube could be slung on the back with the folded waders, straps, and paddles stowed in the open center.

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Soviet sappers reconnoiter a river crossing in an 18ft-long DL-10 folding landing boat (see Plate B3). An SG-43 machine gun is set up in the bow, and most of the soldiers carry PPSh-41 and PPS-43 submachine guns; a high proportion of automatic weapons were essential for scouting missions that might run into a sudden encounter-action. (From the fonds of the RGAKFD in Krasnogorsk via Stavka)

ENGINEER BRIDGE UNITS

Virtually all World War II divisions possessed an organic engineer battalion with three or four companies. They assisted infantry troops with breaching obstacles and minefields and defeating fortifications. They assisted or advised divisional units with emplacing obstacles, mines, and camouflage, and constructing field fortifications and facilities, and they spent much time maintaining roads and bridges to keep supply routes open. They also built temporary bridges, and emplaced floating and fixed bridges.

At the war's beginning most armies had a dedicated pontoon bridge company organic to the engineer battalion. It was quickly found that their division did not always require their services, while other divisions needed them much more, so it was more efficient to centralize bridging units to be allocated as needed. There were several types of bridge units equipped with different bridges, and separate bridge companies and battalions were allotted at corps and army level. Their assignments often changed along with the needs of the formations they supported.

The need for bridging support could be forecast. When divisions neared rivers the necessary bridging units and other crossing assets could be concentrated and dispatched to assembly areas for immediate employment. When bridges too long for the bridge units' organic equipment were needed, that did not mean additional units were committed; rather, additional equipment was drawn from engineer depots. Likewise, when a bridge unit turned its operation over to a relieving unit it did not take the original equipment with it, but drew additional equipment from depots and moved on.

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Sarralbe, Germany, December 15, 1944: Brockway bridge-erection trucks of the 60th Engineer Combat Battalion, US 35th Inf Div, emplace the final treadway sections on a short bridge using five 12-ton pontoons (compare with Plate F). Relatively short spans like this were a far more frequent task for the engineers than long bridges over major rivers. (Tom Laemlein/Armor Plate Press)

Besides the division's organic engineer battalion, it was common for one or more additional engineer battalions to be attached, along with bridge units as needed. It was standard engineer units that actually prepared bridging sites, erected the bridges and maintained emplaced bridges, so units had to be trained to work with several types of equipment. The specialized bridge units themselves were mainly tasked with the delivery of bridge materials, but did of course assist with emplacement and maintenance. As the divisions advanced, other engineer units would take over the maintenance of the bridges, or replace them with heavier-capacity types or semi-permanent timber bridges; the recovered tactical bridges could then be taken forward. Even forces in the defense or retreat needed bridge units to maintain supply lines, shift forces, replace destroyed bridges, and open new withdrawal routes.

Bridge units were normally kept busy. The US 889th Engineer Treadway Bridge Company, for example, built 49 bridges between June 1944 and April 1945 in France, the Netherlands, and Germany. These varied in length from 24ft to 1,048ft, and almost half were over 100ft long. For many years after World War II, timber and steel bridges erected by Allied combat engineers remained in place throughout Europe, serving the civilian populations.

There were a wide variety of bridging units in any army, and only the most common types can be discussed here.

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It took old-fashioned muscle power to lever the 2,400lb steel treadway sections into position so that locking pins could be sledgehammered in. The 15ft-long sections were hinged to allow flexing when heavy vehicles passed over. (Tom Laemlein/Armor Plate Press)

US bridging units

Each division had an organic **combat engineer battalion** of three or four companies, responsible for the full range of engineer tasks. In regards to river-crossing operations this included the preparation of fords, stream-crossing expedients, use of assault boats, and construction of vehicle ferries, portable bridges, and pontoon bridges. They did not possess bridging components, but built the bridges and ferries from materials supplied by separate bridge units. (An armored division's engineer battalion originally had its own bridge company, but these were separated from the battalions in late 1943 to become treadway bridge companies.) However, the organic combat engineer battalion did possess 15x two-man reconnaissance boats and 14x assault boats.

D

BRIDGE TRANSPORT

The launching of waves of assault boats, the emplacing of bridges (whether fixed or floating), and the establishing of ferry and raft crossing-points all depended on the timely delivery of large numbers of boats, pontoons, and a wide variety of bridge components – structure, supports, decking, ramps, braces, and so on. All of this was bulky and heavy; bridging units required a great deal of road-space on already congested lines of communications, and the timing of the delivery of components was critical. Engineers of all armies used a variety of vehicles to transport and erect bridges.

(1) Brockway 6-ton 6x6 B-666 bridge-erector truck

The US Army was able to erect treadway bridges with supported ramp and pontoon components in record time thanks to the "Brockway." The truck was fitted with an erector derrick, and carried pontoon bridge sections and other components. It backed up to a work site, and the vehicle's big double-armed boom hoisted pontoons, pontoon saddles, decking, and supports out of the cargo bed and lowered them to where they could be nudged into place by engineers. It also had a power winch at the front.

(2) Quick-Way Model E crane on Mack 6-ton 6x6 truck

The US "Quickway" was a multipurpose vehicle used by Engineer and Quartermaster units alike. It could be rigged as a hoisting crane, a pile-driver, or a clamshell, dragline, or bucket shovel. It could dredge shoreside boat slips, clear access ramps to bridge sites, and hoist and emplace pontoons and bridge components.

(3) Canadian Ford F60H 3-ton 6x4 folding-boat lorry

This view shows it carrying 3 British Mk III fold-flat boats; the same vertical stanchion arrangement, but without the storage boxes behind the cab, accommodated 2 rigid pontoon boats. There was a hand winch in each of the 4 vertical stanchions, to lower the boats to bed level or lift them after loading. The same assembly was also mounted on US Diamond-T 4-ton 6x6 trucks.

(4) German Pf 15 bridge-component trailer

German bridging columns used 4-wheel trailers, towed by 6-wheel cargo trucks or 5-ton SdKfz 6 medium prime-mover halftracks. They could also be rigged for a six-horse team. Examples were the Pf 10 for bridge trestles and shore planks, the Pf 11 for heavy pontoons, and the Pf 12 for ramps. Illustrated here is a Pf 15, carrying 2 Bridge Equipment C full pontoons (i.e. 4 half-pontoons, linked stern to stern). Accessories and equipment were carried under the pontoons. Pontoons were normally painted "field gray" (dark green), but were sometimes camouflage-painted. Rigid assault boats were transported upside down in nests of 3 on the SdAnh 108 trailer, with the 3 dismounted engines carried on the trailer bed beneath them. The deck sections of the later marks were detachable to allow nesting, and were secured to the trailer's sides.

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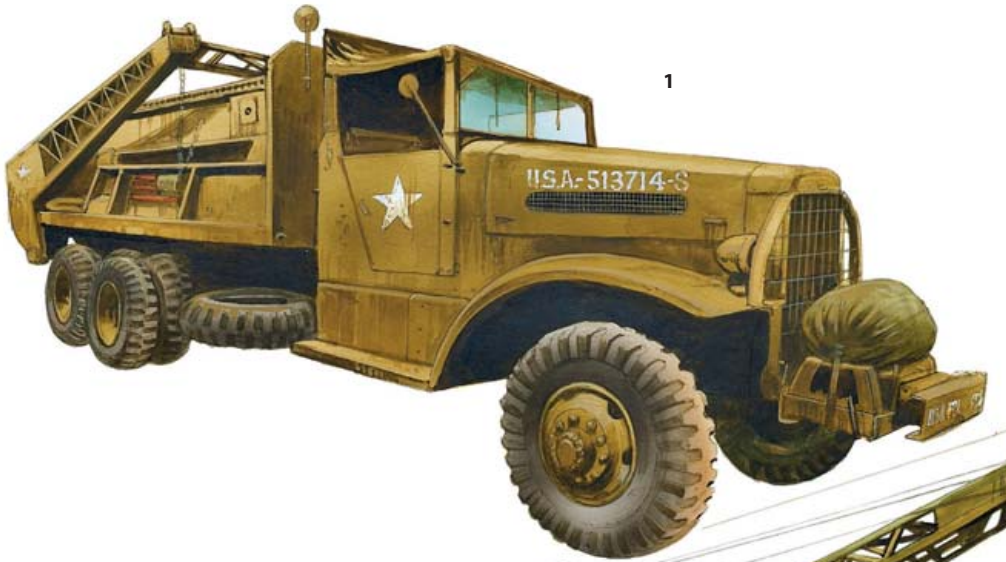

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Bridge units were assigned to field armies and allotted to corps and divisions as necessary. The **treadway bridge company** had a company headquarters, and two bridge platoons each with a 540ft treadway bridge. As an example of how bridge companies were equipped, the 144-man treadway company possessed 4x jeeps, 17x 2½-ton trucks, 3x 6-ton bridge-erection trucks, 1x 5-ton wrecker, 1x halftrack, 2x truck-mounted cranes, 2x bulldozers, 4x compressor trucks, and two utility boats. The 225-man **light pontoon company** had a headquarters, two bridge platoons, and a light equipage platoon. The latter held a crane, bulldozers, 70x assault boats, 12x infantry-support rafts, 4x infantry-support ferry sets, and one M1938 footbridge. Each bridge platoon had an M3 pontoon bridge set or two M1938 sets. These companies were also employed to transport Bailey bridges. **Panel bridge companies** had two platoons, each with a Bailey bridge unit on semitrailers; once the bridge components were offloaded the companies could be employed as dump-truck units.

The 400-man **heavy pontoon battalion** had a headquarters and service company, which held specialist equipment such as cranes and 64x storm boats, and two bridge companies. The bridge companies had two platoons, each with a set of M1940 25-ton pontoons transported on semitrailers. They too could haul Bailey bridge components, two bridge sets per company. Out of the hundreds of engineer battalions raised, there were only 18 heavy pontoon battalions. Three-battalion **engineer general service regiments**

Identifying engineer troops

In the **US Army**, Corps of Engineers personnel and all other troops assigned to an engineer unit, regardless of their job specialty, wore a brass two-turreted castle insignia on service uniform collars. The Engineer branch colors were scarlet and white, displayed as striped twist-cord piping on enlisted men's garrison caps.

British personnel of the Corps of Royal Engineers were identified, like the other arms of service, by a colored cloth strip 2in long by ⅜in wide worn on both upper sleeves of battledress uniforms below any formation insignia; for the REs it was halved, the front half red and the rear dark blue. Additionally, in service dress an arc-shaped shoulder title might be worn at the top of each sleeve, 'ROYAL ENGINEERS' in dark blue on red; on working uniform this was sometimes replaced with a black-on-khaki 'RE' loop slipped onto the shoulder straps. Officers' shoulder-strap rank insignia were backed with dark blue. The bronze cap badge bore the Royal cipher 'GR' within a crowned Garter with motto, above 'ROYAL ENGINEERS' on a scroll, all set on a wide laurel wreath. Royal Army Service Corps personnel, including bridge companies, were distinguished by yellow-on-dark-blue shoulder titles, yellow/dark blue sleeve strips, and yellow backing to officers' rank insignia. The RASC cap badge resembled that of the RE but set on an eight-point "starburst" rather than a laurel wreath.

Red Army engineers (инженер – *injener*, or сапер – *saper*), like the other technical arms, displayed black collar patches; theirs had royal-blue piping, plus black piping on shoulder straps, uniforms, and caps, and a black band on the service cap.

German engineer troops (*Pioniertruppen*) displayed black piping on enlisted ranks' shoulder straps and black cloth underlay to officers' shoulder cords. *Pioniersoldaten* displayed the unit number on their shoulder straps; bridge troops additionally had a Latin "B," bridge columns "BK," and transport battalions for bridge equipment "BT." These ciphers were embroidered in black (with white edging if on dark green shoulder straps) for enlisted men and junior NCOs, silver metal for senior NCOs, and gold metal for officers. (*Waffen-SS* pioneers also used the black branch color.) Enlisted men of **boat units** wore an anchor on their shoulder straps from 1944. *Sturmboot* crewmen were highly trained specialists; the *Steuermann* (helmsman) and *Bootsmann* (boatswain) had to hold *Steuermannsschein der Klasse I b* ratings, and sported an oval left-forearm patch displaying an anchor and ship's wheel.

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Bologna, Italy, May 1945: crossing this steel M2 treadway pontoon bridge over the Reno river are 4-ton 6x6 long wheelbase cargo trucks, hauling two-piece 25-ton steel pontoons and other bridging components. These trucks were especially developed for the engineers. (Tom Laemlein/ Armor Plate Press)

performed specialty and rear-area construction tasks, but also emplaced assault bridges and constructed semi-permanent bridges. Sometimes companies were converted to transport bridge equipment, as the need to move it to the front became pressing during the Allied advances.

British bridging units

Infantry divisions possessed a Royal Engineers headquarters ("headquarters RE") with three field companies and a field park company. Armored divisions had one less field company, but usually possessed a bridge company. **Field companies** did the work of bridge emplacement, while bridging components, pontoons, and assault boats were supplied by **Royal Army Service Corps bridge companies** assigned at corps and army level. (The RASC was responsible for the transport of most of the British Army's logistic needs.)

The RASC bridge company was an extremely flexible unit. There was no fixed organization; each company comprised varied types and numbers of platoons as required by its area of operations, and platoons and sections could be exchanged between companies. The company had a large headquarters, and might typically consist of three Bailey bridge platoons each with 150ft of bridging; two pontoon platoons for Bailey bridges; a heavy bridging equipment platoon with additional Bailey bridging to erect Class 70 bridges; an assault engineer platoon with 40x assault boats and 40x recce boats, plus 150ft of kapok foot-bridging; two folding-boat platoons with 32x FBEs each; a Class 50/60 raft platoon with 20 pontoons, to build four rafts for tanks and artillery; a small Royal Engineer platoon for labor; and a workshop platoon for maintenance.

The Bailey was not the British Army's only fixed bridging equipment, though it became the most successful and famous. Here, in Scotland in October 1942, Royal Engineers lay a portable Class 50/60 bridge over the River Spey. Able to support any tank in the inventory, this equipment was first taken into action in the Mediterranean in 1943. (IWM H 24855)

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Any competent engineer unit had to be capable of improvising under pressure, and Soviet sappers were masters at making-do with what was to hand. Here they struggle to construct a bridge using local materials – pine logs, and steel girders recovered from a wrecked factory, laid over heavy pontoons. (From the fonds of the RGAKFD in Krasnogorsk via Stavka)

Soviet bridging units

By the end of 1941 the Soviet divisional engineer battalion had been reduced to company size and had lost its pontoon platoon. Thereafter bridging support was provided by independent engineer bridge battalions and regiments assigned at army level. Bridging units were mostly truck-transported; the equipment was well designed, and all types of pontoons could also be used for rafts and ferries. Outboard motors of 10hp and 15hp were available for these, as well as for assault boats.

The 250-man **independent light bridge battalion** had three companies each with four platoons. It could build a 200–250ft pontoon bridge with a 5–14-ton capacity within 1½ hours. It was equipped with the DLP-43 light bridge set using plywood pontoons, which could also be used as assault boats and in the construction of rafts. There was also a 300-man battalion equipped with the NPL folding plywood pontoon boat, also usable as an assault boat or for rafts; this battalion could assemble a 500ft bridge in 2 hours. Additionally, there were 750-man light bridging regiments, with two battalions.

The 300-man **independent medium bridge battalion** had two four-platoon companies, and could assemble a 325ft, 30-ton pontoon bridge in 2½ hours. They were equipped with N2P, N2P-41, or DMP-42 medium bridge sets, using 17ft 5in half-pontoons made of steel, which could also be assembled into three-pontoon ferries and rafts. Most tanks could cross these bridges. The engineer park of tank and mechanized corps held another 300ft of medium bridging. There were also 700-man **independent heavy bridging regiments** with two battalions of four companies each; these could erect bridges of 60–100 tons capacity in 3 hours.

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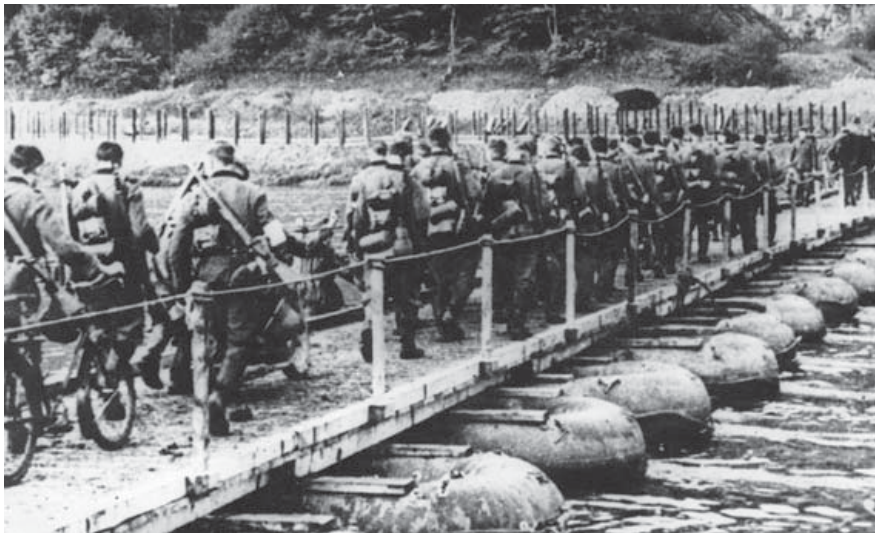

A German infantry column crossing a pontoon bridge fitted with stanchions and hand-ropes. This is of either 4-ton or 8-ton capacity, such as could be constructed speedily by a Bridge Column C or B. The timber treadway is fixed to lengthways beams, over crossways timbers lashed down to inflatable pontoons. The current looks fairly swift, and the inflatables have anchor cables leading upstream. Typically such bridges were linked to the banks with 3m steel ramps, as also used to cross ditches. A body of troops marching in step might cause a floating or suspension bridge to sway violently or buckle – thus the traditional order to "Break step." (Private collection)

German bridging units

The Germans raised 35 Brückenbau-Bataillone (bridge-construction battalions), which were redesignated Pionier-Brücken-Bataillone (engineer bridge battalions) in late 1943. The battalion had four bridge companies, a depot company for materials, and a machinery platoon with heavy equipment. They also formed 19 Brücken-Kolonnen-Staffeln (bridge column staffs) to manage the many company-sized bridge columns transporting bridging equipment. There were also Transport Abteilungen für Brückengerät (transport battalions for bridge equipment).

Bridge columns bore a suffix letter indicating the type of equipment (Brückengeräts) they carried. The 111-man Brückenkolonne B (Bridge Column B) had two platoons, and carried 16x half-pontoons, 24x large inflatable pontoons, and 48x small inflatable boats plus 2x motor boats. They also carried bridge ramps and bridge and ferry fittings. The unit could erect 83m (274ft) of 8-ton bridging on half-pontoons, or 54m (178ft) of 16-ton bridging on full pontoons (two half-pontoons fitted end to end). Using half- and full pontoons, various combinations of 4-, 8-, and 16-ton ferries could also be built, powered with large outboard motors.

A 53-man Brückenkolonne C possessed 10x light half-pontoons, 16x large and 48x small inflatable boats. They were used to construct up to 84m (277ft) of 4-ton capacity bridging, or several 2- and 4-ton ferries; no outboard motors were provided for the latter. Infantry footbridges could be erected using the small inflatable boats.

The 82-man Brückenkolonne K had only four large pontoons. These were in three sections: two ends and a middle section. Other equipment included decking, bridge trestles, ramps, etc. This class of unit provided a 16-ton, 46m (152ft) bridge capable of supporting light tanks, as well as 16-ton ferries using four complete pontoons.

Wehrmacht heavy trucks crossing a 16-ton bridge constructed from the equipment of several *Brückenkolonne K* units, with trestle deck sections and large three-section steel pontoons. Here all three sections are used; for lighter loads the two ends of the pontoon were linked directly. (Private collection)

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Near Olervaux, Luxembourg, a dismounted armored infantry heavy MG squad from US 6th Armd Div cross an infantry-support bridge. This was constructed using M2 assault boats and a single plywood treadway; a similar bridge using pairs of assault boats attached end to end and two treadways could support the light vehicles organic to an infantry battalion. (Tom Laemlein/Armor Plate Press)

BRIDGING EQUIPMENT

FLOATING BRIDGES & FERRIES

Pontoon or floating bridges date back to at least the 11th century BC in China, and were commonly used by ancient Greek and Roman armies. The 1700s and 1800s saw extensive use of pontoon bridges, and pontoon units were established using purpose-built pontoons; the French developed a copper-hulled pontoon as early as 1670.

Floating bridges could be anything from simple footbridges for infantry up to assemblies allowing heavy tanks to cross. Most pontoons were still made of wood, but metal boats came into wide use before World War II, and inflatable boats were developed at the same time. Smaller pontoons, both rigid-hulled and inflatable, could also be used as assault boats and, conversely, some floating bridges used plywood folding boats as pontoons. Inflatables required some form of supporting base or "saddle" set atop the boat, to which the bridge treadway could be attached. Metal and wooden boats were often made as "half-pontoons;" with flat stern plates fitted with attachment brackets, these could either be used alone, or fastened together in pairs end to end to double the weight capacity. Spare pontoons and treadway decks had to be available to replace battle-damaged material, but there were instances when locally acquired boats were used to support expedient floating bridges, especially by the Soviets and Germans.

Besides the treadway supported by pontoons, there needed to be ramps or bridge sections with adjustable supports to connect the floating bridge to the banks, and the pontoons had to be anchored against the current. High flow speed and floating debris could damage or break apart floating bridges, and too heavy a load crossing over could buckle the bridge and flood the pontoons.

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German troops have rigged this basic ferry across a stream using the inflatable three-man *klein Schlauchboote 34*; ropes tied to both ends of the "floating sack" allowed it to be pulled back and forth surprisingly fast. In the background, engineers can be seen bringing up timbers to construct a raft using other inflatable boats; *Brückenbau Pioniere* (bridge-construction engineers) were nicknamed *Balkenträger* – "beam-carriers." (Private collection)

Ferries and rafts

One hears little of ferries and rafts used in river assaults, yet they were extremely useful. Once the far bank was secured by assault troops, and while bridges were still being built, ferries delivered the first heavy support weapons, tanks, and other vehicles. This equipment was pushed across immediately behind the assault troops so that they did not have to wait for hours for bridges to be completed. Ferries also came into their own when the current speed was too great for stable floating bridges, or a river was too wide for the bridging materials at hand.

Technically, "ferries" were powered, usually by outboard motors fitted to one or more of the pontoons but also by powerboats towing or pushing them, while "rafts" had to be pulled from shore to shore by cables using manpower or vehicles, or else rowed or poled. Exceptions to this distinction may be seen, and both were constructed the same. Most tactical ferries used two, three, four, or six pontoons decked over with standard bridge treadway. The ferries were run across the river with the pontoon bows pointed shoreward and the decking crosswise; when approaching the far bank they turned with the pontoons parallel to the shore, to align the deck end with the exit ramp. A powerboat or man-hauled lines and poling might aid in this maneuver, especially in swift currents. Ferries were usually fitted with folding ramps for loading and unloading, but simple planks might be used, or ramps pre-positioned on both shores. With little modification ferries could be incorporated into pontoon bridges as they were constructed.

Parts of the Soviet Union – notably in the far North, and in the central Pripyet sector – were covered in extensive swamps, marshes, and chains of small lakes. While shallow, these were still significant obstacles; troops forced to wade across them quickly became exhausted, and frozen in cold weather. Much use was made both of commandeered light boats, and of improvised rafts; here the Red Army crew of a 45mm M1942 AT gun, and infantry squads, pole themselves along on nearly-submerged plank rafts. Unless log and lumber rafts were buoyed with sealed fuel cans or drums, they rode very low in the water. Two stacked wooden doors lashed together might barely provide sufficient buoyancy for one man, but might also sink if the wood used was too heavy. (From the fonds of the RGAKFD in Krasnogorsk via Stavka)

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The trestle supports for steel treadway bridges were normally used for the entry and exit ramps to pontoon bridges, but on narrow, shallow rivers they could also be used to make an entire stand-alone semi-fixed bridge, as here on the Serchio river in Italy (see also Plate A2). The treadway was designed for vehicles larger than the jeep, whose axles could only barely straddle the central gap. (Tom Laemlein/ Armor Plate Press)

FIXED BRIDGES

Fixed bridges were those that spanned the river from bank to bank, with or without intermediate supporting piers or pilings depending on their length. Military tactical bridges might be all-steel or timber, and were provided in prefabricated sections with all necessary fittings and accessories. Fixed-bridge engineer units were assigned at corps or army level. Besides erecting prefabricated portable bridges, they could also repair or even build larger permanent replacement bridges, often using tactical bridge components. Such bridges might be built on the site of an original destroyed bridge, often using existing masonry piers and abutments (the massive masonry ends of a fixed bridge). This speeded up construction, conserved materials, and made use of existing approach and exit roads.

E

GERMAN RAFTS & FERRIES

Rafts and ferries were extensively used by all combatants to move AT weapons, tanks, and other support weapons and vehicles across to a bridgehead during the vulnerable period while bridges were still being constructed. Rigid or inflatable pontoons of various capacities, with added bridge sections for decking, were used for this purpose.

Here, a *leicht Sturmboot 39* **(1)** is used to push a 4-ton capacity ferry, consisting of two Bridge Equipment B half-pontoons fitted with a 12m deck section. This could carry a light truck, field car, artillery piece or similar load. Here it is returning from the front line carrying casualties and medical personnel.

In the background **(2)** is an 18ft *mitte Schlauchboot* (medium inflatable boat, known as a "*grosse Flot Sack*"); this could be propelled by six paddlers, but here troops on both banks draw it back and forth by means of ropes hitched to the ends. Note the planks lashed to each side to support the wheels of a 3.7cm PaK 35/36 antitank gun, arranged so that its center of mass is over the boat's center of gravity. Alternative loads might include a 7.5cm infantry gun, or a motorcycle/sidecar combination.

Just visible on the slope of the far bank are two pairs of 3m assault bridge sections (*Aussenbord*), used to bridge small gaps like ditches and also the space between rafts or ferries and riverbanks.

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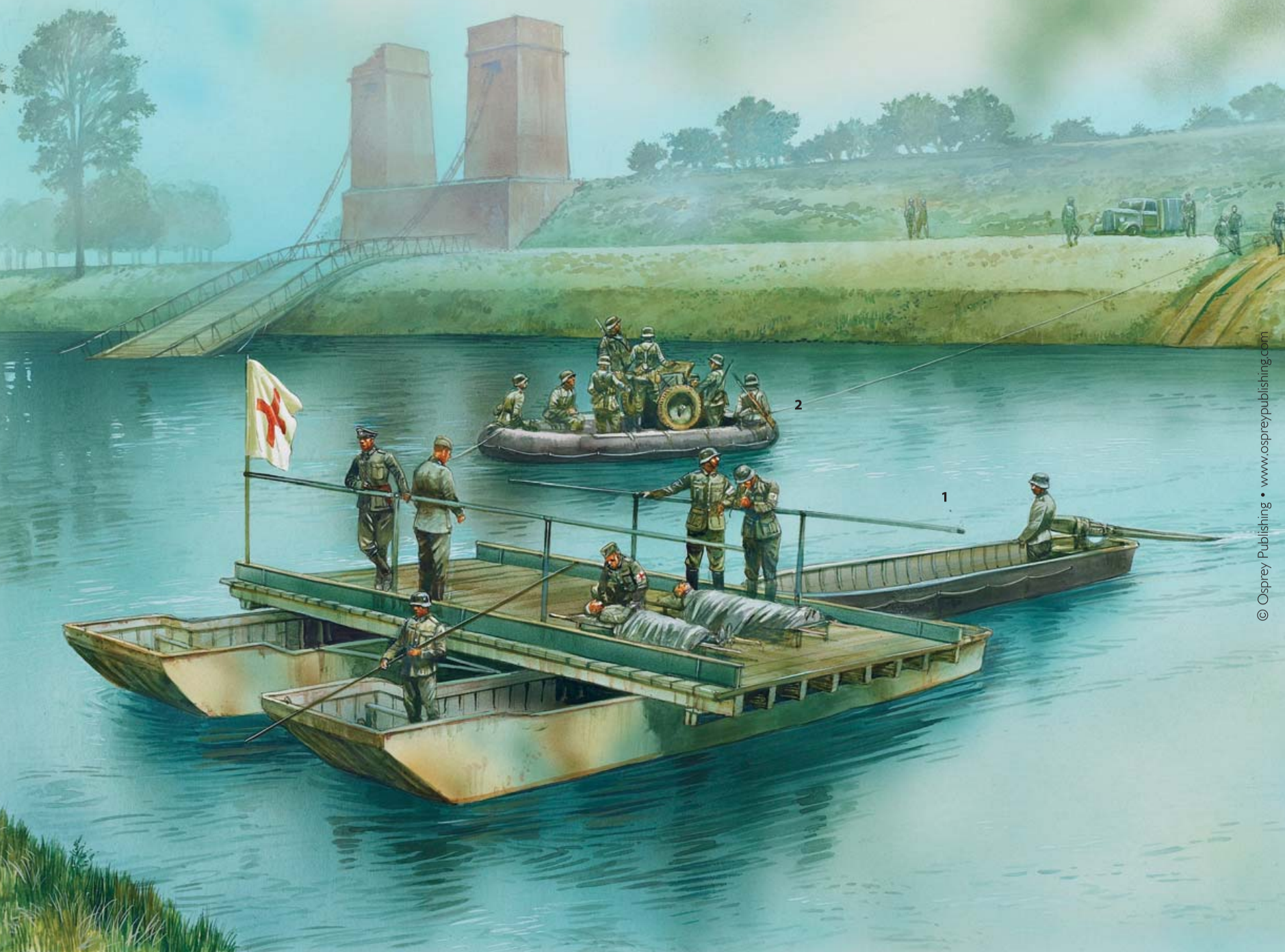

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Bridges were provided with prefabricated decking or treadways, support trestles and beams, side railing, ramps, piers, and other supports. Some steel supports might be telescoping to allow for height/depth adjustment. Bridge supports for deep gorges and other high bridges were built of wooden beams stacked crisscross to the necessary height, and pinned with large spikes. It might require days to construct such bridges. (There were instances when even tanks and other vehicles lost on collapsed bridges were incorporated into the new bridge's supports.)

When a retreating force destroyed permanent bridges, often only one or two spans were dropped by demolitions. These were relatively easy to replace using prefabricated bridge elements. Timber and steel pilings had usually been destroyed, but robust brick and masonry piers might be spared, which aided in reconstruction. After the Allied invasion of France, the Germans made the mistake of only dropping spans rather than blowing the pilings and abutments; this made demolition faster, and used fewer explosives – abutments were very heavily constructed, so required much greater charges. (The Germans were initially optimistic; they hoped to recapture lost ground, and to use the existing abutments to rebuild bridges themselves.) Allowing the abutments to survive permitted the Allies to quickly repair the bridges and continue the tempo of the offensive. Later the Germans began destroying abutments, if sufficient demolitions were available.

Prefabricated bridges like the Bailey design (see below) proved to be highly effective. Such bridges needed to be able to bear the army's heaviest loads, from 40 tons up to 70 tons, including heavy tanks, tank transporters, and heavy artillery. There were instances when even railroad and dual-lane highway-type bridges were built, but these were well after the assault phase.

Military load classification

A vehicle/bridge weight classification system was developed by the British Royal Engineers in 1938, and was later adopted by the US and other Allied forces. By 1943 its visible sign was a yellow disc with a black one- or two-digit load class number, painted on a vehicle's right front fender or hull or on a metal disc fastened to the grille. It was not always present, and is seldom visible under the clutter and dirt in frontline photographs. Class numbers were also posted on signs at the entrance to bridges; only if a given vehicle type had a class number less than or equal to the bridge's classification could it cross (classifications were also assigned to ferries and rafts). Classifications ranged from Class 3 up to Class 70, spaced at regular intervals. It is often assumed that these numbers are the vehicle weight in tons; they were usually close to the actual tonnage, but not always. For instance, a typical Bailey bridge was Class 40, but they could be built to take Class 70 vehicles. The system took into consideration wheeled vehicles' loaded weight and the number, spacing, and load of axles; for tracked vehicles the combat weight, track width, and length were calculated. Tables with pre-calculated classifications were available, so that drivers/crews did not have to deal with these complex formulas. Engineer officers would also calculate the weight classification of intact civilian bridges.

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EMPLACING BRIDGES

A lengthy German pontoon bridge built using *Brückengeräts B* (Bridge Equipment B), with rigid half-pontoons – note the flat stern plates. In the right foreground is one of the tripod trestle supports for the entry-ramp decking. At left, engineers shove off a decking section assembled on two half-pontoons, and prepare to pole it along the upstream side of the bridge to the uncompleted end, where it will be pushed into place by motorboats. (Private collection)

While there were minor differences in how different types of pontoon bridges were constructed, especially between those using rigid or inflatable pontoons, methods of assembly and positioning were generally similar.

German Bridge Equipment B pontoon bridge

The Bridge Equipment B was one of the most commonly used. A motorized Bridge Column B was equipped with trucks and halftrack prime-movers for towing trailers with pontoons, decking, ramps, wooden planks, and motorboats. As described above, 16 steel half-pontoons used either paired or singly allowed the assembly of a bridge either of 8 tons capacity and 83m (274ft) long, or bearing 16 tons and 54m (178ft) long. The deck sections had steel stringers, and curb guards with 26 wooden planks. There were eight trestle sections consisting of roadway decking supported by adjustable steel posts, each with three bracing legs. These allowed ramps to connect to the floating bridge when the bank was higher than the bridge's roadway, or when the water near the banks was too shallow to float pontoons; they also allowed ramp-angle adjustment as the river rose and fell.

Several types of ferries could also be constructed, and a trailer was provided with cable reels which could pull these back and forth. A half-pontoon was 12ft long and 5ft wide, and a ferry capable of carrying 4 tons required two half-pontoons and one bridge deck section. An 8-ton double ferry used four half-pontoons and two deck sections, and 16-ton ferries used two full pontoons and two deck sections. The full-pontoon bridge and the 16-ton ferry could in fact support any vehicle and equipment found in the infantry or early-war armored infantry division, to include a Panzer IV tank or a 15cm howitzer and its halftrack prime-mover.

The half-pontoons were unloaded from the trailers; each needed 30 men to carry it, so if full pontoons were to be used then two half-pontoons were fastened together only once they were in the water. A full pontoon could be rowed into position by eight men using extremely long oars, but at 25ft long it was difficult to maneuver. When used for bridges or ferries, the pontoons

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Preparation of entry and exit ramps for tactical bridge sites was critical; here, engineers spread brick rubble on an approach ramp. Heavy vehicles would soon press the rubble down into muddy ground, and further layers would have to be added for as long as the bridge was in use. (Tom Laemlein/ Armor Plate Press)

were linked together side by side with two pairs of 4ft-long V-shaped brackets fastened to the side of each half-pontoon. Whether for a ferry or a bridge, the first half- or full pontoon was positioned parallel with the bank and the others positioned further out and parallel with it. The deck sections were manhandled into position atop the pontoons, and steel curbs and railings fitted. While the pontoon sections were being assembled, another crew was erecting the trestle bridge sections linking the shore to the floating bridge.

Up to 12 pontoons could be assembled in a section, and pushed into place from downstream by the motorboats. Sections initially used as ferries could later be incorporated into the bridge. The pontoons were held in place by upstream anchors. For lengthy half-pontoon bridges a pair of full pontoons might be set in the center the better to support loads. With the near-shore trestle ramp completed and the pontoons in place, a crew crossed by boat and ferry and erected the far-side ramp. The most difficult part of the operation was actually the preparation of the entry and exit roads; in the Wehrmacht bulldozers and other power equipment were seldom available, and the job had to be done with pick and shovel.

The Bridge Equipment B might span a stream with four pontoons and two ramp sections, or might include scores of pontoons. Just as in the US Army, there were instances where bridges over very shallow rivers were built entirely of trestle sections, without pontoons; for example, the Dniepr was spanned by 32 trestle sections.

US M2 treadway pontoon bridge

Most German bridge units were horse-drawn, relied on manpower for labor, and had to inflate pneumatic pontoons with foot-pumps. Their US Army counterparts had the enormous advantages of being entirely motorized, and equipped with Brockway bridge-erection trucks with integral derricks, crane-trucks, air-compressor trucks for pontoon inflation, and bulldozers for site preparation. This example describes the erection by a treadway bridge company of a US M2 treadway bridge with inflatable pontoons; this spanned a 230ft-wide river in just 2 hours. (Later, more experienced engineer units could construct a treadway at a rate of 200ft an hour.)

F

ERECTING A TREADWAY BRIDGE

Here, US Army combat engineers construct an M2 treadway floating bridge from the near to the far bank of a German river, which is flowing from right to left (note anchor lines from pontoons, secured upstream). Various sizes of inflatable and steel boat-pontoons could be employed – here, 33ft x 5ft 6in inflatables, moored 3ft 9in apart **(1).** Three steel treadway sections have been erected on trestle supports to act as a ramp down the steep near bank **(2).** Using the ramp, a Brockway erector truck **(3)** has now finished unloading pontoons and hoisting 12ft x 3ft 9in treadway sections onto their steel saddles. Bridge sections are being readied to be moved to the far bank, and an 18ft utility powerboat is pushing a two-pontoon section **(4)** against the current, to be linked to the other end section **(5).** When that first section was pushed across it was used as a ferry to carry the Caterpillar D4 bulldozer **(6),** so that it could begin clearing an exit road from the bridge site. A bridge like this could be erected in 2–3 hours, depending on the width of the river and the speed of the current; naturally, it took longer when the water was flowing fast.

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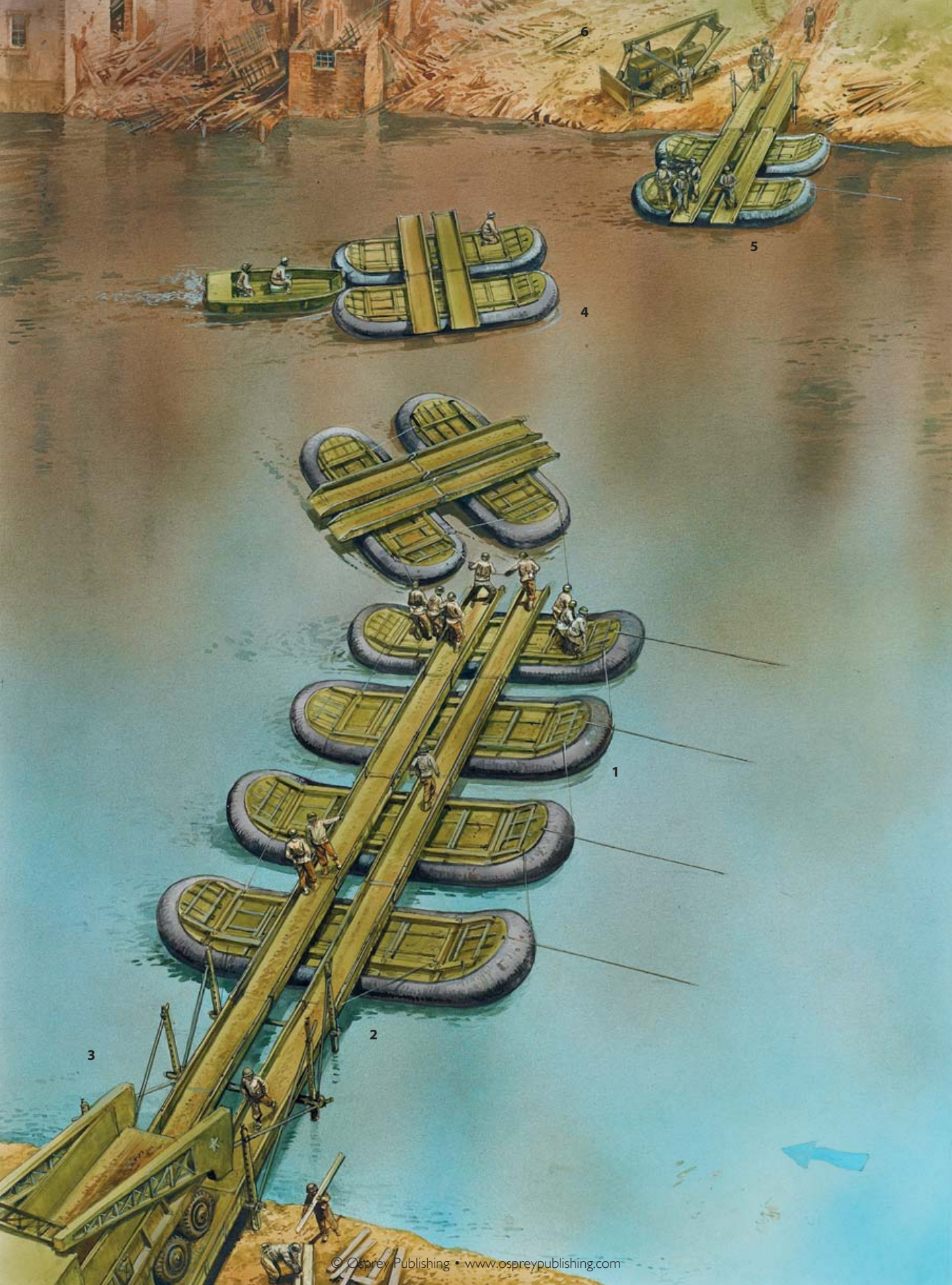

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An M2 treadway bridge across the Lahn river, a tributary east of the Rhine. Just visible on the far bank are a damaged pneumatic pontoon, and one of the spares held ready to replace those damaged by enemy artillery fire. The M3A1 halftrack crossing the bridge belongs to the 27th Armd Inf Bn, US 9th Armd Div; three weeks previously, men of Co A of this unit led by Lt Karl Timmermann had seized the Ludendorff railroad bridge at Remagen. (Tom Laemlein/Armor Plate Press)

In the camouflaged dispersal area the bridge components were assembled to the extent possible. The first Brockway was backed into position on the riverbank, and its load of pontoons was pulled from the truck. It had already been determined how many pontoons were needed. The 20-ton capacity pontoon was 33ft long, 8ft 3in wide, and the tube 33in in diameter. It could still support its rated weight even if some of the 16 air cells were punctured.

The pontoons' canvas sun-protection covers were removed, the air valves were opened, and the pontoons were inflated by gasoline-powered compressors taking 5 minutes each. The Brockway used its derrick to unload the steel bridge saddles and treadway decks; two men could do this, instead of the eight it would need to do it manually. The three-section saddles were hinged together and two I-beams fitted for rigidity. Each saddle was hoisted onto a pontoon by a Quick-Way crane-truck, and secured by straps and buckles at 4ft intervals along the pontoon's sides.

With a pair of pontoons ready in the water, a Brockway backed partly into the river. Two parallel but separate 2ft-wide, 15ft-long treadway sections were hoisted crossways onto the pontoon saddles and latched in place. The first assembly was used as a raft; loaded with a bulldozer, it was pushed by a bridge-erection powerboat across the river. Offloaded on the far bank, the bulldozer began preparing the landing site and an exit road. If the far side was boggy it might require additional resources and equipment to prepare the site and exit.

When three two-pontoon sections were ready they were fitted together, with two long steel pins linking the ends; these pins spanned the width of the two treadways, and made the bridge rigid. The first pontoon-and-treadway section was positioned on the far side. Subsequent sections were assembled and pushed across, and connected from the far side back toward the near side. This kept the near bank clear for assembling more pontoon sections. To hold the bridge in position, 200lb anchors were fastened to the upstream ends of some or all pontoons, depending on current speed; these were carried 50 yards upstream by boats, and dropped. Bridge-erection or powered assault boats might have to hold bridge sections in place against the current until the anchors were dropped. As the last pontoon section was shoved into place and the end ramps were connected, a wireman laid a telephone line across, hung over the pontoons and not on the treadways; if the unit was under artillery fire a second line might be laid on the other side of the treadways for backup. The telephone was used for traffic control, and to let the nearside crossing CP know the situation and repair needs on the far side. Spare pontoon sections with saddle plates and treadways fitted were held ready to replace damaged sections.

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The versatility of the Bailey bridging system is dramatically demonstrated in a photo taken at St Jean Rohrbach, NE France, in November 1944. Any solid support could be used, including this overturned M4 Sherman Jumbo assault tank. Here the bridge is of the most common "double-single" type – two panels thick and one panel high, each side of the treadway. Depending upon the required strength and the distance to be spanned, any combination could be used: from a "single-single" one panel thick and one high, to a "triple-double" with three panels side by side, two high. (Tom Laemlein/Armor Plate Press)

British Bailey fixed bridge

General Eisenhower declared that the three most important engineering and technological achievements contributing to victory were radar, heavy bombers, and the Bailey bridge. Field Marshal Montgomery wrote that "I could never have maintained the speed and tempo of forward movement without large supplies of Bailey bridging... It was the best thing in that line that we ever had."

In 1939, work on a tactical bridge capable of taking a 40-ton load was begun by Donald C. Bailey at the Experimental Bridging Establishment, and his perfected design was adopted in 1942. Its first use was in Tunisia in November 1942; the first to be erected under fire was in Sicily in 1943, and it went on to be used extensively in Italy, Northwest Europe, and the Far East. It owed its success to five design factors: (1) It was extremely versatile: it could be constructed in variable-length spans, could be reinforced using standard prefabricated components, and could be used for either a fixed or a floating bridge. (2) Its components were of light, welded construction, and none weighed more than 600lb, so each could be lifted by no more than six men. (3) While manufacture was widely dispersed, all parts were interchangeable with those manufactured by other companies. (4) All components fitted into the British Army's standard 3-ton lorry and, luckily, into the US 5-ton dump truck. (5) The overall design was simple to construct, with a minimum of manpower and heavy equipment, and without special tools or vehicles.

The principal components were 570lb steel-lattice side panels (10ft long x 5ft high); 445lb transom girders (18ft crossbeams for the deck); 10ft-long x 1ft 9in-wide stringers, laid lengthwise on the transoms; bracing frames for connecting multiple panels; 12ft-long, 2in x 9in wooden-plank decking; 3ft x 4ft 7in baseplates weighing 470lb, with bearing rollers; and various pins, bolts, and other fittings. They could be floated on pontoons, but were more often erected as fixed bridges using the surviving original abutments and

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Porretto, Italy: a US Army Brockway 6-ton 6x6 bridging truck crosses a "double-double" Bailey bridge, each side being constructed with two lattice panels bolted side by side, two panels high. A problem occurred with US-made Bailey bridges, officially designated "panel bridges." The Canadian-supplied gauges were poorly made or damaged, and numerous US-made panels would not fit other US and British components. The British command in Italy directed that only British-made components would be accepted; the defective components were tracked down and replaced, as were the gauges. (Tom Laemlein/Armor Plate Press)

supports, if any, of a destroyed bridge. The key to their erection was site preparation; if the solid pilings and abutments were ready when the components arrived, 60–80ft of bridging could be completed in 2–3 hours.

The bridge was assembled in 10ft sections with at least two side panels connected by two transom girders, and six stringers running lengthwise. Across these were laid 13 deck planks, and wooden curbs were bolted onto both edges. Bolted end to end, these sections made a strong box structure, which could span 240ft unsupported by pilings or pontoons. (Of the thousands built, the longest Bailey was a 1,154ft pontoon bridge spanning Burma's Chindwin River.)

Depending on the width of the gap to be spanned, the first sections were assembled without longitudinal stringers and wooden decking, to reduce weight. The sections were bolted together and, as completed, were shoved forward successively by means of the roller bearings set in the baseplates – a process called "launching." The first section was angled upward about 15 degrees; this "launching nose" was guided onto baseplates on the far side, even if one bank was slightly higher than the other. While additional sections were attached and pushed across, another crew fitted the stringers and decking. Once they were in place, wooden catwalks could be fitted across the ends of the long crossbeams protruding beyond the side panels; these allowed two-way foot traffic while vehicles crossed the main trafficway. Two bridges could be erected side by side for two-way traffic.

The beauty of the Bailey bridge was that two or three of the lattice panels could be butted together side by side for strength, as well as additional ones being stacked one above the other, to create extremely strong bridges. The most common was a "double-single" – two parallel side panels fixed together on each side of the trafficway, one panel high.

Forty men could construct a 60ft "single-single" in 3–4 hours, and a 300ft "double-single" could be built in 36 hours. As mentioned above, the organic platoons of a typical RASC bridge company had the materials to build three 160ft Class 40 "single-double" bridges, or two plus a 110ft Class 70 bridge. Sometimes bridge panels were so seriously damaged by fragmentation from enemy fire that they were unusable; the torn pieces were simply cut out and additional reinforcing panels attached beside or atop the damaged panels. Panels could even be erected on end as frame pilings, and set at 60ft intervals to support any length of bridge. Later in the war, reinforced Baileys proved able to support the ever heavier equipment then being introduced, such as the tank-mounted mine roller and the 240mm M1 self-propelled howitzer.

The Bailey bridge was so successful that many remained in civilian use for years after the war, and a few may still be seen even today.

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Protecting bridges

Whether a permanent bridge captured by good fortune, a fixed replacement, or a pontoon bridge, all had to be protected from enemy attack. The enemy might counterattack to retake the crossing site, bring down mass artillery fires, launch air strikes, or attempt infiltration or commando-style attacks. (When the US unexpectedly seized the Remagen bridge over the Rhine the Germans went so far as to launch seven V2 missiles at it, sent in Me 262 and Ar 234 jet fighter-bombers, and attempted an attack by Waffen-SS frogmen, all without success.) Besides the troops defending the bridgehead, antiaircraft units covered the bridge, and engineers, infantrymen, and military police were detailed to guard it. Small-caliber AA weapons (.50cal, 40mm, 2cm and 3.7cm Flak, etc.) would be placed near the bridge, and larger-caliber guns (90mm, 3.7in, 8.8cm) a kilometer or more away. Regular air cover might even be provided.

March 25, 1945: well spaced out, British vehicles including a tracked carrier cross "Lambeth Bridge" over the Rhine, a "double-single" Bailey bridge supported by pairs of 30-ton pontoons; note the bracing of the double-thickness side panels. The recommended distance between vehicles crossing a floating bridge was 80ft, taking into account the horizontal "flex" of such bridges. Montgomery's Anglo-Canadian 21st Army Group made their successful assault crossings over the Rhine on March 22/23, at Emmerich, Rees and Rheineberg north of Düsseldorf. In this stretch the river was 350–500 yards wide (narrower at sharp bends), and 10–14ft deep. (IWM BU 2417)

Spare bridge components, extra pontoons, and repair crews were positioned nearby in order to repair damage quickly. Bridges also had to be protected from sudden rises or drops in water level; an increase in the speed of the current or high winds could bring floating debris downstream, some of it big enough to threaten pontoon bridges. Cables could be stretched across at water level to snag this debris, and coiled concertina wire fastened across the river both helped to net any floating debris and hampered enemy combat swimmers. Floats were used to support cables and nets on wide rivers; in extreme cases heavy wire nets might be used, but these were difficult to clear of accumulated underwater debris. Such buildups could tear cables loose, and had to be cleared by work parties using powerboats.

Often two or three floating bridges were emplaced in the same general area, one for vehicles and one or two for infantry. This might be done even if the original permanent bridge was still in place; it was sensible to have backups, and to disperse the crossing sites over a wide area to make them harder to interdict with artillery. A light infantry pontoon bridge could be emplaced upstream both as a "guard" barrier to catch debris and to allow sentries stationed on it to detect swimmers. For the same purpose assault boats, no longer needed now the bridge was in place, might be strung across a river secured bow-to-stern, or could be used for patrols.

Floating contact-detonated or time-delayed demolition charges might be sent downstream in hopes of them snagging on a pontoon bridge, but these attempts usually failed. Combat swimmers might attempt to come downriver to emplace demolition changes, provided with some form of flotation and camouflaged as debris; at Remagen the German swimmers used Italian underwater breathing apparatus. These attempts, too, seldom succeeded; fast currents swept the frogmen past their targets, or alert guards upstream detected them. Searchlights swept across the water's surface, and powerboats patroled the river; hand grenades and demolition charges tossed overboard at any suspicious sighting were devastating to swimmers.[1]

1 See ELI 177, *German Special Forces of World War II*, Plate H

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THE CONTESTED RIVER CROSSING

Seizing bridges intact

There was nothing more desirable for an advancing army than to capture bridges intact, especially over major rivers. The seizure of the Ludendorff railroad bridge over the Rhine at Remagen on March 7, 1945 is considered a perfect example of aggressive action and immediate exploitation of a tactical advantage.[2] Such successes depended on a combination of leadership, timing, tactical prowess, and the fortunes of war.

Bridges were often seized by reconnaissance units or small spearhead task forces speeding ahead of the main body. This is one reason most armies fielded well-armed and highly mobile reconnaissance units. They could fight for intelligence, but they could also exploit the situation to seize key terrain and features that facilitated the advance, and that included seizing bridges, fords, and ferries. There were many instances when a routed enemy did not have the time to establish an effective defense – which often depended upon the terrain – or to emplace demolitions, which was itself a lengthy process. Sometimes the spearhead force was able to seize secondary bridges and ferries even though the defenders destroyed bridges on the main routes. While of lesser capacity than the main bridges, these were no less valuable.

The greatest danger was, of course, to those who crossed the bridge first. The wise attacker would send dismounted troops across first; advancing armor invited immediate detonation, whereas the defenders might feel confident of dealing with a few infantrymen. However, those infantry would be desperately seeking to find and cut demolition firing wires, so the charges might be blown anyway. There were instances where a few men were able to infiltrate the bridge unseen and cut the wires while the defenders waited for the expected tanks.

If a bridge could be seized in this manner and the firing wires cut, the next step was to get infantry, tanks, and AT guns across to establish at least a toehold to secure the bridge against counterattack, if not yet a true bridgehead. The defenders would also bring the bridge under artillery fire and even air attack, in hopes of at least damaging it and hampering crossing troops and vehicles. Most often, however, bridges were destroyed before the attackers' arrival by demolitions or burning (or in some cases, even collapsed under the weight of a too-heavy lead tank crossing). Then a river assault had to be conducted.

SELECTION OF CROSSING SITES

The selection of crossing sites was extremely critical, and there was more to it than enemy dispositions and river width. Common perspective suggests that the narrower the crossing point, the less exposure there would be to enemy fire. However, narrow points offered significantly faster currents, making it difficult for boats to cross and floating bridges to be anchored, and often it was better to select a wider point with slower currents. Water depth was also important – the shallower it was, the swifter it would be. Bottom composition affected the anchorage of bridges, since it is difficult to set anchors firmly in mud or silt.

2 See CAM 175, *Remagen 1945*, and ELI 177 *German Special Forces of World War II*, Plate H

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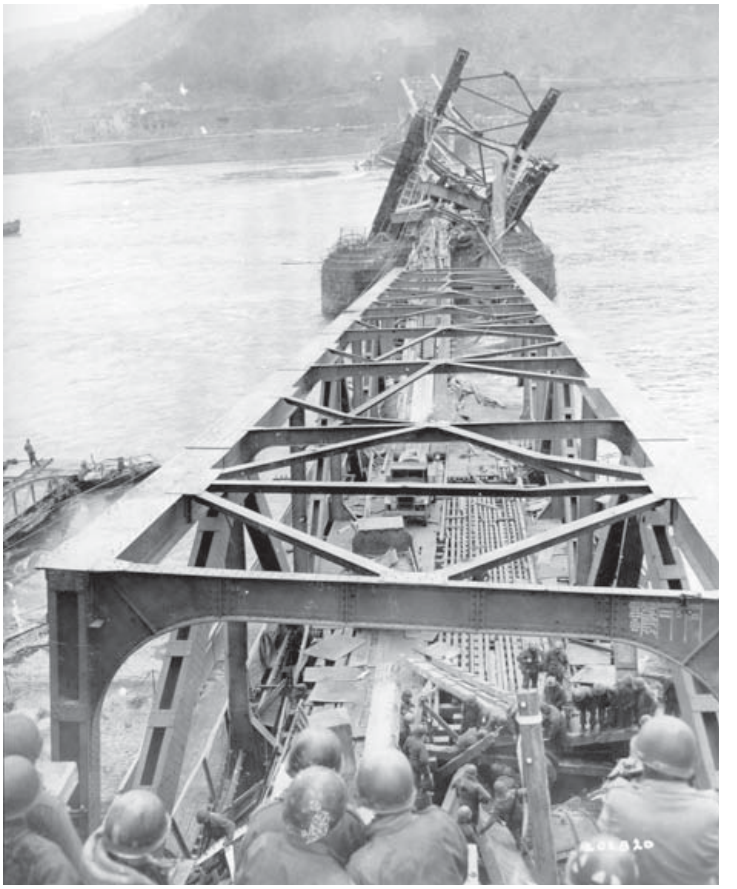
It was one thing to select a crossing site because of its ease of access on the near shore, but the terrain on the far bank was the more important. The assault unit's initial and follow-on objectives, exits from the shore, and access to the road system were critical. The location of the objectives was the foremost factor in the selection of crossing points, and every effort was made to select undefended or lightly defended sectors.

Road access into the assault area was important in order to deliver boats, troops, supplies, and bridging equipment. Dumps were established, and units moved into assembly areas. Closer to the river were the assault positions or forming-up points from which the infantry and engineers would move the boats to launch points – the river's near bank doubled as the "line of departure" or start line. These dumps and areas had to be concealed from ground and air observation, as did the troops' approach routes to the crossing sites. The steepness of the bank and the ground conditions had to allow infantry carrying boats to reach the water's edge. Suitable positions for supporting weapons covering the far side were essential. Likewise, the far banks had to be climbable and/or offer exit trails. The exits from the landing sites had to provide firm ground, cover and concealment, and allow access to roads. It would be a real problem for one bank to be at or near water level, and the opposite side higher, since whichever side the higher bank was on required considerable engineering work to provide access/exit points at bridge level. Pre-existing ferry crossing sites were ideal for pontoon bridges since they had existing access and exit roads, and ferry landings on both banks were suitable for supporting bridge ends as they were at the same level.



After its dramatic capture by Co A, US 27th Armd Inf Bn on March 7, 1945, the Ludendorff railroad bridge over the Rhine at Remagen was quickly flanked by new tactical pontoon bridges both up and down stream. On March 17 the railroad bridge, weakened by the initial German demolition attempts, collapsed into the river; by then, however, the US bridgehead was firmly established, and a Bailey bridge was also opened to traffic on March 20. (Tom Laemlein/ Armor Plate Press)

Current speed had to be considered: if it were too fast, it would carry even powerboats downstream before they could reach the far shore. On occasion landing sites were deliberately selected much further downstream from the launch site as a deception, so long as there were few or no enemy positions along the intervening shore past which the boats would have to "run the gauntlet." Multiple landing sites might be selected to provide for multiple toeholds to be gained, with the most successful of these receiving the follow-on forces.

The bridge sites would not necessarily be the same as the boat-landing sites. Bridge sites required firm ground on both sides, access and exit roads capable of supporting heavy vehicles, and areas for dumps and supporting weapons. A boggy shore or mudflats could mire exposed assault troops and vehicles.

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It was desirable for defendable terrain to be near at hand to the landing site, on which to establish a bridgehead defense line; ideally there would be subsequent lines of defendable terrain, to allow the bridgehead to expand. In large operations there might be two or more bridgeheads miles apart, which would subsequently expand toward one another and link up.

PHASES OF THE CROSSING OPERATION

Once the sites had been selected, then, irrespective of which army was conducting it, the assault of a river followed several logical phases. Some might be abbreviated or skipped if at any point the enemy was disorganized and routed, or if time constraints prevented every step from being completed:

Map reconnaissance and planning

By studying maps and aerial photographs of the selected crossing and bridge sites (photos were especially valuable, since they showed "real time" features such as the present seasonal width), the division or corps engineer commander could forecast the needs for assault boats and bridging equipment. He would request these from higher echelons in good time, so there would be no delay in their delivery once the river was reached. He should also have forecast the equipment needed to break out of the bridgehead once it was established, for instance if there were subsequent water obstacles to be crossed (e.g., where a canal paralleled the river as part of an overall system of water traffic management).

Rehearsals for all elements involved in major river assaults were essential, and before the US Third Army's Rhine crossings the units practiced on the Maas river. As infantry board an M2 assault boat, one of the three engineer crewmen hands out paddles; sandbags have been wrapped around the gunwales to muffle the knocking and scraping sound of paddling. These GIs no doubt fervently hope to comply with the sign: "Swimming Forbidden." (Tom Laemlein/Armor Plate Press)

G **GERMAN BRIDGEHEAD, *c.* 1941**

Here, an imagined German attacking force has established a bridgehead after assaulting from the north to the south bank.

While platoons from the assault unit's sister battalions defend the near shore each side of the river bend, nine rifle platoons **(P)** and the assault battalion command post **(CP)** have crossed to the south bank. They are supported by regimental elements, flak, and an engineer company maintaining the pontoon bridges and ferries. Military police would conduct traffic control. Roadblocks **(RB)** and minefields **(M)** have been placed. This bridgehead would have to be expanded to accommodate a breakout force.

The original masonry bridge **(1)** was destroyed. A 4-ton Bridge Equipment B using half-pontoons **(2)** has been emplaced upstream from it, and a footbridge using Bridge Equipment C on small inflatable boats **(3, and inset)** downstream. A 4-ton ferry **(4)** is operating upstream from the 4-ton bridge. Engineers always strove to establish multiple bridges and ferries to ensure redundancy of capacity in case of loss to enemy action, weather, or accidents. From the north bank, support for the bridgehead is provided by a platoon of 5cm AT guns **(5)** covering the fields south of the village; within the bridgehead, two more platoons of AT guns cover the fields **(6)** and enfilade the main road **(7)**. The assault battalion's 8cm mortar platoon **(8)** covers the whole frontage, as does the regimental 12cm mortar platoon **(9)** from the north bank. A platoon of 4x 2cm AA guns **(10)** is positioned in the bridgehead for close-in support. On the north bank, a platoon of 3x 3.7cm AA guns **(11)** covers the bridge and ferry crossing, while a battery of 4x 8.8cm dual-purpose AA/AT guns **(12)** covers both sides of the river to include the bridgehead. A battery of 4x 10.5cm howitzers **(13)** supports the bridgehead; off this page, two more batteries of that battalion plus other artillery battalions would also provide support.

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The real thing: at Lille-St Huberet, France on September 19, 1944, British infantrymen carry Mk III FBE folding assault boats shoulder-high as they move up to their start line for crossing the Meuse-Escaut Canal. This boat had a rigid wooden bottom but collapsible canvas sides, and weighed 940lb. As was often seen in NW Europe, several of the Tommies carry full-size engineer shovels and picks thrust under their web gear; these enabled infantrymen to dig in a lot faster than with the individual entrenching tool. (IWM BU 960)

Initial approach

The advance elements of the army reached the river, drove off enemy rearguards and mopped up bypassed pockets. A major effort was naturally made by spearhead elements to seize any remaining bridges before the enemy could destroy them. If the enemy had established a bridgehead on the near side to protect crossings, then this would have to be reduced or at least contained; while an altogether separate operation from the assault crossing, it was an essential accompaniment. Engineers cleared mines, booby traps, and obstacles on the near side.

Ground reconnaissance

The approaches to the crossing sites and, if possible, the far bank were reconnoitered in detail. If the far side could not be reconnoitered, then intelligence was collected by ground and air observation. Patrols that did manage to reach the far side would attempt to collect information on natural and man-made obstacles, minefields, roads, trails, and enemy positions. Local civilians, especially those whose occupations gave them knowledge of the river, were interviewed, and any prisoners of war were interrogated. Abandoned barges, boats, bridge-construction or road-building materials, and other engineer supplies were located.

Positioning assault, artillery, supporting, and engineer units

These units were designated and moved into assembly areas. Extensive coordination was undertaken, plans were developed and refined, and training

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While engineers were working to build the first bridges, it was essential to get tanks and tank destroyers across to consolidate the bridgehead against counterattacks. Here an M36 of 803rd TD Bn, attached to US 4th Armd Div, is ferried across the Rhine on a timber deck laid on three 28ft-long 10-ton pontoons. The ferry is pushed by two 18ft utility boats, and an engineer nurses an Evinrude 22hp outboard motor on one of the pontoons. Navy LCMs were also used to carry armor across during the Rhine operation. Over its whole length the Rhine varies in width from 200 to 500 yards, and in depth from just 6 to 16 feet. At the point in the Oppenheim sector, between Mainz and Worms, where troops of Gen Patton's US Third Army crossed successfully on March 22/23, 1945, the river was between 300–350 yards wide and 12–17ft deep. (Tom Laemlein/Armor Plate Press)

undertaken, especially by the infantry and engineers launching the assault. If possible, rehearsals were conducted on another river, or at least "dry" rehearsals. At the same time the assault boats, ammunition, supplies, bridging equipment and materials were delivered and stockpiled close to the assault positions. Assault units might have been selected from the reserve of the division/regiment that had reached the river; alternatively, completely fresh units might have been brought forward for the assault, depending on the expected resistance and available time. Assault positions were selected, and troops issued ammunition, rations, etc. Deception efforts might occur during this phase. Artillery would be registered.

Fire preparation

Artillery and mortar fire would be placed on known enemy defensive positions, reserves, artillery positions, command posts, etc. Fires would be preplanned to engage deploying reserves and counterattacks. Fighter-bombers and light bombers would attack enemy reserves and other positions and facilities. Normally bridges on subsequent streams/rivers on the far side would not be attacked, to retain them for breakout, but selected bridges not used to advance the main attack might be destroyed to protect the flanks. Artillery and mortars would often fire smoke to blind enemy positions and observers.

Assault crossing (see also Plate H)

Many assault crossings were conducted at first light, although this hampered the movement and launching of assault boats. River mist and fog might be present, offering a degree of concealment, though also a risk of confusion. Ideally, the assault would occur when the rising or setting sun was shining across the river into the defenders' eyes. The artillery would concentrate on enemy defensive positions, obstacles, and artillery. Smoke generators or smoke pots might be used to screen the assault boats if the wind was blowing from the near side; if it was blowing from the far bank, the artillery would fire smoke on that shore to drift back across the river. On the other hand, while potentially providing lifesaving cover for the assault boats, smoke might hamper the attack, especially in finding the proper landing sites. (General Rommel, when commanding 7. Panzer-Division in France in spring 1940, used artillery to set fire to a riverside village, and the resulting smoke screened troops crossing by inflatable boats.) Supporting direct-fire weapons on the near side would also cover the assault.

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Establishment of the bridgehead (see also Plate G)

The assault force had to establish a viable short-term defense on the first defendable terrain, termed the bridgehead (German, *Brückenkopf*; French, *tête de pont;* Russian Предмостное, *kredmostnoe*; Italian – *testa di ponte*). Enemy forward observers were driven off, defensive fires established, and AT mines laid on avenues of approach, covered by AT guns. The flanks of the bridgehead had to be secured as soon as possible, at least with screening forces. This allowed time for the improved ferries and bridges to be emplaced so that additional forces and logistics could cross and prepare for the breakout. Typically, a substantial force including armor had to be built up inside the bridgehead to ensure the success of the breakout; piecemeal attacks by units as they trickled across the river might not succeed. The sooner the breakout from a bridgehead occurred the better, in order to prevent the defenders from reinforcing the containing force.

Consolidation

Pontoon footbridges would be emplaced first, to rush infantry reinforcements across to make up for the losses among the assault waves. Ferries and barges would carry AT guns, tanks, artillery, and other support. Casualties would be evacuated at the same time.

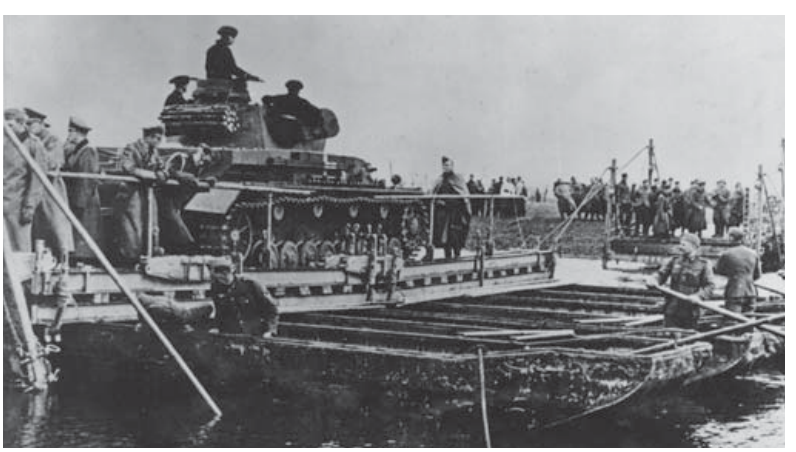
Reinforcement

Unless enemy resistance was light and disorganized, or they possessed inadequate mobile reserves, the assault force had to build up strength and resources before it could conduct a breakout. Even if unable to break out, such bridgeheads were often maintained to tie down enemy defenders while breakouts from other bridgeheads were launched. Additional pontoon bridges, ferry services, and boat relays would be established. More infantry and supporting weapons would be delivered, to include the forces designated for the breakout, along with more supplies and ammunition. The bridgehead might be physically enlarged during this phase.

Breakout

Like the assault crossing itself, the breakout would commence with artillery and air support. The breakout would most likely be conducted by fresh troops, while the original assault troops held the bridgehead. Follow-on units and supply transport would be ready to exploit the breakout.

Given the significant time and effort involved for the attackers to conduct an assault crossing and establish a bridgehead, the defenders might have had time to establish another defensive line further on – which might well be on another river. This may therefore be the place to shift attention from the attackers' preparations, and to consider what the defenders would be doing in the meantime.



As early as their September 1939 campaign in Poland the Germans also used rafts made from bridging components to get armor forward into bridgeheads quickly. Two deck sections secured to four *Brückengeräts B* full pontoons produced a raft with a nominal capacity of 16 tons. However, this photo underlines the fact that this was not its actual limit; here it carries a 25-ton PzKpfw IV tank across a Polish river. (Private collection)

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DEFENSE OF A RIVER LINE

Once bridges had been completed the buildup of forces in the bridgehead could get under way in earnest. Here an M18 tank destroyer attached to the US 4th Armd Div arrives across an M2 treadway bridge over the Moselle river near Müden, Germany. The engineer at the right uses an SCR-536 "handie-talkie" to regulate traffic; in contact with another controller on the far bank, he maintains the intervals between heavy vehicles crossing. (Tom Laemlein/ Armor Plate Press)

Defensive bridgeheads

Bridgeheads are sometimes assumed to be an exclusively offensive concept, but this is, of course, untrue. When a force withdrew across a river to establish a defense on the near bank, a remaining bridgehead would typically be established on the side otherwise abandoned to the advancing enemy. This normally surrounded existing bridge sites, even if the original bridge had been destroyed. In the event there were no established bridge sites in a sector, a bridgehead could nonetheless be established at a site with adequate access and exit roads, and floating bridges and/or ferries would be emplaced. There were three tactical reasons to establish such a defensive bridgehead:

1. It provided a secured crossing site on the far side of the river from which a counteroffensive or local counterattacks could be launched. It also eliminated the need to later conduct a costly assault to secure a crossing site on the far shore in the event of a counteroffensive. This was valuable even if the original bridge had been destroyed.
2. It tied up enemy forces and logistics that had to be positioned to contain the bridgehead. These often had to be larger than the force defending the bridgehead, thus reducing the forces available to the enemy to mount their assault across the river elsewhere.
3. It denied the enemy an existing bridge or developed crossing site, forcing them to make their assault from a less desirable site.

Forces defending such bridgeheads were kept relatively small, to avoid the need for large quantities of ammunition and other supplies to be transported across the river. However, it was important to consider the defendable terrain around the perimeter: the enemy could not be allowed to occupy dominating terrain if at all possible. The area enclosed within the bridgehead had to be large enough to provide depth to the defense, and space for reserve units, supporting weapons, CPs, aid stations, supply and ammunition dumps, etc. Often there was a town or village on one or both sides of the river, and this would be of benefit to the defense of the bridgehead. A built-up area provided cover and concealment, and reinforced the defense with obstacles; it channeled the advance of enemy armor, and restricted the enemy's observation.

If a counteroffensive were to be launched from the bridgehead, it required sufficient space to assemble the offensive breakout force, its follow-on forces, and logistics support. The bridgehead might therefore have to be enlarged through local attacks, to accommodate the offensive force or secure more defendable terrain.

To reduce pressure on space within both offensive and defensive bridgeheads, as well as the amount of supplies that needed to be carried across, supporting artillery often remained on the nearside shore, as did heavy AA providing an umbrella over the bridgehead. Antitank guns and light AA guns could also be deployed on the near shore to at least partly cover the bridgehead's flanks. Employing supporting weapons from the near shore also eliminated the possibility of having to abandon them if forced to evacuate the bridgehead.

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The bridgehead defense force was in a precarious position if attacked in overwhelming strength. There might be little space in which to maneuver and mount counterattacks. Disengaging under pressure was dangerous, and a rearguard would in all probability be sacrificed. There was little doubt that the bridge would be blown before all survivors could withdraw. At best the defense force would be withdrawing across a permanent bridge under fire. In the worse cases they might have to make their way across bullet-riddled pontoon footbridges, flee in rubber boats, or discard their weapons, gear, and boots and try to swim for it.

Defense against an assault crossing

Depending on the tactical situation and terrain, defensive positions were seldom placed directly on the riverbank. This was done in some instances, if the attacking enemy lacked sufficient artillery (which was rare), or when time allowed strong fortifications and obstacles to be developed. However, placing positions on the shore allowed them to be detected or at least suspected, and barraged by artillery, mortars, and direct-fire weapons from the opposite shore. Normally, positions on the defended side of the river would be placed well back, preferably on bluffs, hills, ridges, in forests or built-up areas. While towns on or near the river might be defended, the attackers would seldom cross in their vicinity unless the tactical situation demanded. River islands were usually too small to defend, tied up troops more usefully employed elsewhere, and allowed them to be trapped and eliminated; however, islands might be sewn with mines and booby traps. The attackers might use islands as a blind for launching boats, which would move around the island's end and head for shore, so observers with flares might be positioned to warn of this.

The defender would consider the location of potential boat-launching and bridging sites on the attacker's side when it came to positioning weapons and obstacles. Shores were seldom sewn with obstacles along their full length – there were not enough time or materials. Prime landing sites might have obstacles, especially mines. Minefields might be laid just behind the riverbank,

The Netherlands, 1944: US Army M26 "Dragon Wagon" armored tractor-trucks with M15 tank transporter semitrailers carrying LVT(4) "Alligator" amphibian tractors to launching sites. Known to the British as "Buffalos," these amtracs were used by both Allied army groups for their assault crossings of the Rhine. The same transporters hauled US Navy LCVPs and LCMs inland for river assaults. This extreme example is a reminder of the mass of often very heavy traffic that needed to be assembled before any crossing operation, on overcrowded and damaged road networks. (Tom Laemlein/ Armor Plate Press)

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For the Rhine crossings in southern Germany in late March 1945 the US Navy provided three units equipped with 36ft-long Landing Craft, Vehicle and Personnel (LCVPs), and 50ft-long Landing Craft, Mechanized Mk III (LCMs). Here LCVPs nose up to an embarkation site on the west bank under a gray/white screen generated by smoke pots; sometimes floating smoke pots were thrown out of landing boats while they crossed. At right foreground is a 12-ton capacity pneumatic pontoon complete with the "saddle" that took the treadway. Both the US and Anglo-Canadian armies in NW Europe also had the DUKW-353 ("Duck") amphibious 2½-ton truck, but this was never used for the initial assault; it was both too vulnerable, and too valuable for its other capabilities. (Tom Laemlein/Armor Plate Press)

on roads, junctions, trails, and other avenues leading away from the river. When time allowed, obstacles and mines would also be placed on the attacker's side before withdrawal, to hamper his approach and assembly.

While the defender might not position his forces on the river itself, there would be observation posts (OPs) to warn of attack, and small nests of troops and weapons to disrupt patrols and assault troops. Some automatic weapons might be emplaced near water level to sweep the surface when assault boats appeared. Machine guns might be emplaced to enfilade (fire across) bends and loops in the river. A key factor was the emplacement of forward observers to direct preplanned artillery and mortar fire (this is why screening smoke was so valuable to the attacker). Mechanical time-delay fuses to achieve artillery airbursts were especially useful against boats and floating bridges. Fires would be preplotted to fall on possible marshaling and assault positions, crossing points, exit routes, and defendable terrain on the defender's side that attackers might occupy once ashore. When the attackers had ferries in operation and bridges emplaced the defending artillery would concentrate on them.

Artillery firing on a pontoon- or other bridge at or near water level to interdict crossing troops and vehicles is most effectively positioned to enfilade the bridge (fire down its long axis). Artillery has more dispersion in range rather than in deflection. Near misses to the side can be effective because a shell exploding on the water's surface generates more fragmentation to the sides, with some shrapnel traveling forward and fewer pieces rearward.

CONDUCT OF THE ASSAULT CROSSING

Preparations

A river assault was much like any other assault, with the problematic inclusion of a wet moat between the line of departure and the objective. The river itself was not the objective, but simply an intervening obstacle, albeit reinforced by other obstacles (barbed wire, mines, anti-boat obstacles). As in any attack, regiments, battalions, and companies were assigned zones. The US, British, and Germans tended to assault narrow zones. The Soviets

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preferred broader fronts, believing that to attack on a narrow front quickly cost them the advantage of surprise, allowing the defenders to concentrate on the selected areas. Often, the Germans lacked sufficient mobile reserves to adopt this policy.

While all manner of tasks were being undertaken by different elements in the preparation for the assault, the phases described above were typically accomplished by the echelons from battalion up to division. The execution of the assault at company level provides a view of what an assault entailed for the troops committed.

Ideally the assault units were notified at least 3 days in advance, and 10 days if possible. In fact that luxury was often unavailable, and sometimes an assault might have to be conducted with no preparation, using whatever resources were at hand. Ideally, corps and army bridging assets were forecast and dispatched in good time to reach the front, but commanders quickly learned that line-of-communication traffic jams could delay bridge columns.

The size of the assault force depended on the frontage width, enemy dispositions and strength, and available assault boats. It was not unknown for the Red Army to have engineer units build boats from scratch when time permitted. During their early conquests the Germans often made do with commandeered boats and makeshift rafts. Usually all available boats were used in the first wave, whether this was a company or an entire battalion. When attacking in a narrow zone, each company within a battalion might provide a wave. Each wave might have its own boats if sufficient numbers were available; if not, the first wave would cross and engineer boat-crews would return to pick up the next. In some instances spare boats would be held to replace initial losses.

H

US ARMY ASSAULT RIVER CROSSING

While no two river crossings were exactly the same, this scenario shows in schematic form the assault elements of a US infantry regiment **(blue)** deployed to conduct an assault from the south against prepared German positions **(red)** on the north bank of a river, which is flowing from east to west. The Germans are defending a dominating ridge, and have turned a farm complex into a fortified strongpoint; they have minimal defensive positions on the riverbank itself. The supporting artillery of both sides is off the page.

Vertical blue lines indicate US company/battalion boundaries; the horizontal blue line is the line of departure **(LD).** From left (west) to right (east):

Company A, 1st Battalion is in its assembly area preparing for the assault. In its crossing zone, a treadway bridge and a footbridge are planned for emplacement after the initial landing.

Co B, 1st Bn is also in its assembly area. In its zone, another footbridge and a ferry site are planned. The 1st Bn will attack with these two companies abreast, each accompanied by a supporting engineer element. The two companies' assault boats are pre-positioned on the line of departure.

Co C, 1st Bn is in reserve, and will reinforce whichever assault company is the more successful.

2nd Battalion will attack with its three companies in column; a ferry site and both treadway and footbridges are planned in its zone.

KEY, US:

(1) First-wave assault companies.
(2) Second-wave follow-on companies.
(3) Reserve company.
(4) Engineer elements with bridging equipment.
(5) Engineer elements with ferry equipment.
(6) Engineer elements to clear mines, mark routes, and serve as guides.
(7) Forward regimental OP, with engineer control element.
(8) Battalion CPs, with engineer liaison elements.
(9) Pre-positioned assault boats for lead companies – five boats per platoon, to include attached weapons crews.
(10) Planned footbridge sites.
(11) Planned treadway bridge sites. **(12)** Planned ferry sites.
(13) 57mm AT gun platoons providing direct-fire support.
(14) 81mm mortar platoons.
(15) 4.2in mortar platoon (attached).
Also: (24) Tank and/or tank destroyer platoons preparing to cross aboard ferries.

KEY, GERMAN:

(16) US assault company initial objectives.
(17) Antipersonnel/antitank minefields.
(18) Roadblocks. **(19)** Early-warning OP.
(20) 8cm mortar platoons.
(21) Forward combat outposts.
(22) Defended positions with 5cm and/or 7.5cm AT guns.
(23) Farm complex strongpoint.

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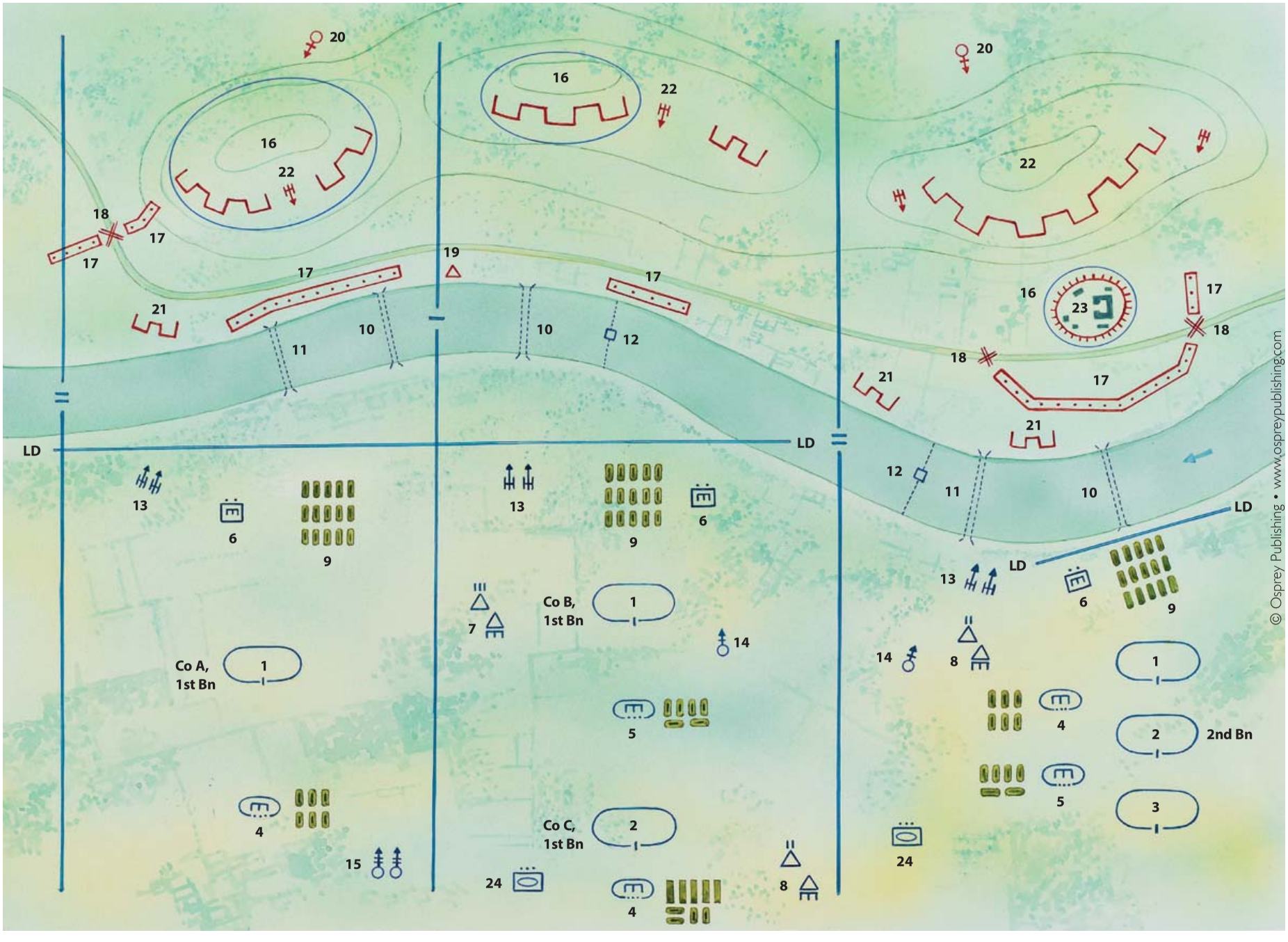
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Assault units would be briefed on the operation; leaders reconnoitered routes to the river, to marshaling and assault positions, and observed the far shore. Coordination between the infantry, engineers, and artillery was essential. Marshaling areas would be established in concealed sites where the infantry and engineers would assemble, and where boats would be delivered. Nearby were areas where rafts and pontoon bridging equipment were prepared. An OP was established to observe the assault zone and landing sites, and to relay events to the various rear CPs. Artillery OPs were also established, and artillery forward observers would be assigned to accompany the assault waves. Considerable artillery was gathered to reinforce assault divisions; for instance, the Soviets massed 240–320 pieces per mile of front. Antitank guns were positioned for direct-fire support.

Routes were marked from the marshaling areas to the assault positions. Engineers would clear areas and routes of mines that the enemy might have left behind, or might even have slipped back to lay clandestinely after they withdrew to the far side. All preparation activity was concealed as far as possible, and often conducted at night. Deception efforts might be conducted up or down stream to mislead the enemy; the Red Army tended to conduct large-scale feints. This might include obvious patrols, movement of assault boats and pontoons into decoy "marshaling areas," artillery registration, increased troop and vehicle activity, machine-gun firing, smokescreening, and flares. The actual crossing might take place at a less-than-ideal site as further deception, but this still had to offer a practicable vehicle exit route. Any diversionary assault would begin before the actual crossing, hopefully deceiving the defenders into shifting forces to face the apparent threat.

The various headquarters would conduct map exercises to establish the sequence of events and prepare timetables. If possible, rehearsals were conducted on a nearby river, even if it was smaller than the one to be crossed under fire. The assault troops needed to be familiar with carrying the boats while in full equipment, launching, paddling, and disembarking. Even if a practice river was unavailable they would "dry run" carrying the boats, and be taught how to paddle. Platoons would be organized into boat teams if the boats were too small for full squads. Machine guns and mortars would accompany the assault waves.

US infantrymen pick up flat-bottomed M2 assault boats delivered by the engineers, to carry them to their line of departure on the bank of the Moselle river. It was reckoned that the maximum distance the assault infantry could reasonably be expected to carry the boats under combat conditions was 300 yards, but this was exceeded in emergencies; in the Rapido operation in January 1944 they had to carry them about a mile. (Tom Laemlein/Armor Plate Press)

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Assaults might be conducted by day or night, the latter being preferred if they faced strong opposition. Blackout conditions and radio silence were maintained. Routes were marked by signs, tape, and dimmed flashlights, and guides would lead the assault troops forward. An ideal situation would be to assault prior to dawn, seize the bridgehead defense line, and be prepared to confront the counterattack at first light.

At a designated time the assault troops moved from marshaling areas to assault positions. They would usually have to carry their boats, but if sufficient concealment existed these might be pre-positioned forward. Noise and light discipline were essential, and carrying the heavy boats while wearing full combat equipment was difficult. Carrying-ropes or handholds were usually near or on the gunwale (the upper edge of the hull), so the hull's bottom hung and might catch obstructions; in this event the boat could be carried upside-down to clear obstructions. For night operations, weapons were typically carried loaded but with no round chambered. Bayonets might or might not be ordered fixed, but this could be hazardous in close-packed boats and inflatables. Sensitive equipment such as radios might be protected. Troops might tape or otherwise protect their weapons' muzzles from water, and unfasten their equipment belts to allow fast removal if they ended up in the water, since life vests were seldom available.

As soon as possible after the landing a tactical pontoon footbridge had to be constructed. Here, on the Roer river in February 1945, GIs of the 9th Inf Div cross into artillery-shattered woodland over an M1938 footbridge. Owing to the fast current the cork-filled wooden floats are ballasted with sandbags on the downstream ends (see Plate A1), and the upstream ends are attached to a cross-river anchor cable. Theoretically, a 180-man rifle company could cross one of these bridges in 3 minutes, but if they came under accurate enemy fire it was a very different story. (Tom Laemlein/ Armor Plate Press)

To the water's edge

At the appointed time the boats were picked up and the troops crossed the line of departure, this usually being the last concealment. From here the boats were carried upright. There would be no increase in covering fire, in order not to alert the defenders. Clambering down the riverbank and crossing boggy ground and vegetation was difficult. If launching from a steep bank boats could not be pushed into the water bow-first, as they would ship water; they had to be launched sideways. A squad automatic weapon was often placed in the bow. Artillery preparation would only begin a short time before the assault was launched, and for night assaults it might be withheld to ensure surprise, until the assault was discovered and the enemy reacted.

Once the boats were committed, then even if they were receiving heavy casualties it was better to keep going rather than turn back still exposed to fire. Moving rapidly to the enemy bank might mask the boats from fire from weapons further back. Troops were told not to return fire from the boats; this was ineffective, and risked hitting men in their own or other boats. Covering weapons on the near bank (AT guns, machine guns, mortars) would open fire. Once they disembarked, boat teams would not halt to organize into platoons, but press inland to their objectives and establish toeholds, no matter how tenuous. Engineers would return the boats, taking wounded with them, and ferry across subsequent waves until rafts and footbridges were in place.

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All armies used rafts and ferries, but the Soviets made the greatest use of them. Rafts and ferries might be carried forward in sections and launched, or assembled upstream facing an unoccupied sector of the far shore and floated down to the crossing area. The first ferries and rafts would carry AT guns, mortars, ammunition, and tanks. A US practice was to carry across cargo trailers loaded with ammunition and simply leave them along the far shore for anyone needing resupply to help themselves. US and British forces would also put at least one bulldozer across to prepare ferry and bridge landing sites. Artillery would begin to be crossed once the far-shore bridgehead was secure and large enough; only one-third of the artillery would be crossed at a time.

At least one, preferably two tactical pontoon footbridges would be established as soon as possible to get more infantry across. These would be followed by the emplacement of a tank-capable pontoon bridge. Depending on the operation's tempo, ferries might remain in operation even after the bridges were open, since they were useful if the main bridge was damaged or traffic backed up.

The assault troops would expand the bridgehead, and at some point dig in for a defense on favorable terrain to meet a counterattack. Behind them the breakout force built up. A major goal was to drive away the defenders' forward observers, so as to hamper the direction of attacks on the bridges and the bridgehead itself. Other engineer units would arrive to emplace a heavier semi-permanent bridge, such as a Bailey or a timber bridge, or they might rebuild the original destroyed civilian bridge. Engineer units either left their tactical bridges in place or recovered them when more substantial replacements were built. They were soon busy preparing for the next crossing.

FAILURE: THE RAPIDO RIVER

In a book of this size, space does not permit detailed study or comparison of actual assault crossings. The descriptions already given of the "textbook" organization, equipment, and preparations associated with Allied operations in particular, coupled with the knowledge that their Italian and NW European campaigns were ultimately successful, may leave some readers with a superficial impression that – despite the obvious dangers faced by the first assault waves – success in such operations was a foregone conclusion. This is very far from the truth, however. An examination of the Rapido crossings in Italy in January 1944 will provide some insight into what could happen when the planning and preparations for a crossing operation went wrong.

Mission and preparation

In mid-January 1944, US and British Commonwealth forces were stalled by the German defenses anchored on Monte Cassino near the southwest end of Field Marshal Kesselring's "Gustav Line." It was decided that US Fifth Army (Gen Mark Clark), with II US Corps (Gen Geoffrey Keyes) and X British Corps (Gen Sir Richard McCreery), would attack westward across the Rapido and Garigliano rivers, both of which ran roughly north-south and met in a confluence south of Cassino. Apart from the immediate objectives, it was hoped that this would provide a diversion for the Anzio landings on the west coast planned for January 22, and would thus draw German reserves away from Anzio and Rome. Relations between senior US and British command echelons were fractious, however, and coordination was less than perfect.

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January 19, 1944: British infantrymen double across a Mk III "folding boat equipment" bridge over the Garigliano river, well within German artillery range. The terrain suggests that this photo was taken near the estuary, where 5th Division trusted to surprise rather than artillery support to get two battalions across on the night of January 17/18. A bridgehead was established, and held against a counterattack by Panzer-Regiment "Hermann Göring," but the arrival of other German reinforcements stalled the planned breakout. The Mk III FBE used new steel deck-bearing beams, and a 14ft deck section on two boats could also be used to ferry trucks or artillery. (IWM NA 10942)

Beginning on the night of January 17/18, two British divisions in Fifth Army's left flank made crossings at separate points on the lower Garigliano; although they both established bridgeheads of varying strength, these came under heavy counterattacks that prevented any immediate breakout. The third British crossing, by 46th Division, was planned for January 19/20 opposite Sant' Ambroglio; this was to take high ground dominating the southern flank of the sites about 4 miles further north that were selected for the US 36th Infantry Division's crossings on the following night. However, in response to the earlier crossings the Germans opened sluices at San Giovanni on the Liri river, turning 46th Division's narrow stretch of the Garigliano downstream into a raging torrent. Fourteen separate attempts to get boats across with cables failed, and on the morning of the 20th the attempt was suspended as German artillery blanketed the near bank. The high ground to the south of the American crossing sites thus remained unsecured.

At the US crossing sites the Rapido, though flowing south at a speed of 8mph, was otherwise an apparently unimposing obstacle; it was 25–50ft wide and 9–12ft deep, with banks between 3ft and 6ft high. In some areas the east (American) shore was flooded owing to winter rains. The American shore was lower than the German side, and its open, saturated fields offered little cover; there were only a few dirt roads to carry boats and bridging materials forward, and those were deep in mud.

What was imposing, however, were the German defenses on the west bank. In the center of the American crossing zone was a 40ft bluff on which the village of Sant' Angelo sat 550–700 yards beyond the river. The veteran 15. Panzergrenadier-Division (Gen Eberhard Rodt) had demolished houses, built fortifications, and dug-in assault guns, machine guns, and mortars, while caves in the rear sheltered artillery and troops. T-shaped fighting positions and concrete bunkers 30–40ft apart overlooked the river's length close to the bank. There were barbed wire, mines, booby traps, and trip flares

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not only on the German side but on both shores, and most of the trees and brush on the American side had been cut to deny them cover. US engineers attempted to clear the near shore of mines, but there were so many and in such irregular patterns that they could only clear some lanes 10–12ft wide and mark the larger minefields – and by night the Germans crossed and planted more mines. The entire area was under observation from high ground on both flanks, and German artillery, Nebelwerfers, mortars, and machine guns could blanket both shores with preplanned and observed fires.

The 36th Infantry Division (Gen Fred Walker) was supported by its 111th Engineer Combat Battalion, and two companies from the 16th Armored Engineer Battalion. Battalions of the 19th Engineer Combat Regiment were also attached to the two assault regiments, the 141st and 143rd Infantry. (The 142rd Infantry was in reserve to lead the breakout, and the 36th Reconnaissance Troop was to cross later and screen the southern flank of the bridgehead.) The 111th Engineers provided 119 assault boats and 113 pneumatic reconnaissance boats, and was to build two Bailey bridges for tanks and heavy weapons once the river was no longer under artillery fire. No floating footbridge equipment was available, but they would construct several makeshift bridges using catwalk sections and pneumatic boats. The 19th Engineers would provide 20 assault boats and 30 pneumatic reconnaissance boats, and was to construct a treadway vehicle bridge, four improvised footbridges, and a Bailey bridge after Sant' Angelo was seized. Twelve DUKW amphibious trucks were requested, but denied; it is doubtful whether they could have been used anyway, owing to the steep, muddy banks.

The 141st Infantry would cross at one site north of Sant' Angelo, 1st Battalion assaulting with three companies abreast. The 3rd Battalion would follow, using returned boats and five footbridges. The reserve 2nd Battalion would "demonstrate by fire" and feint a crossing elsewhere. The 141st was supposed to seize a bridgehead between 1,100 and 1,500 yards deep. The 143rd Infantry would cross well south of Sant' Angelo, its 1st Battalion crossing with companies in column. The 3rd Battalion, also in a column of companies, would cross further south, and 2/143rd was to be ready to reinforce either attack. Each battalion's lead company would use boats and the others footbridges, two per battalion. The whole operation would be supported by

US infantrymen practice rapid debarkation from an M2 assault boat on the Maas river, during rehearsals for the Rhine crossings in March 1945. (Tom Laemlein/Armor Plate Press)

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Jülich, Germany, February 24, 1945: an M1938 footbridge over the fast-flowing Roer has been broken by the strong current – an artillery hit would obviously achieve the same result. During the Rapido crossings of January 1944, no M1938 sets were available, and the footbridges had to be improvised from catwalks and small inflatable reconnaissance boats. They came under heavy fire over 3 nights and 2 days, and were repeatedly broken, repaired, and broken again, leaving assault troops isolated on the far banks – which, unlike the wooded shore seen here, were bare muddy ground thickly sewn with mines. Note in the foreground a cork-filled wooden pontoon float, and a scow-shaped M2 assault boat. (Tom Laemlein/Armor Plate Press)

16 artillery battalions, plus tank, tank destroyer, and mortar battalions from the 1st Armored Division. The artillery preparation would last for 30 minutes.

There were problems with the preparations, and only 3 days were available. The rehearsals on the Volturno river 10 miles away were controlled by Fifth Army rather than by 36th Division. The Volturno was slower and had lower banks; the troops were not taught proper boat-carrying or launching methods, and paddlers were not designated. Significantly, the 142nd Infantry participated in the rehearsal, but was then replaced for the assault by the 141st, which did not. It was expected that trucks would deliver the boats and bridge components directly to the river shore, but the rain-soaked dirt roads proved to be impassable quagmires. There was little effective coordination between the infantry and engineers, and they could not agree on the bridge sites. Intelligence was poor, and patrols crossing to the German side captured few prisoners.

The 36th Infantry Division was tired after severe mountain fighting at Monte la Difensa and San Pietro Infine, and morale was low. There was a high percentage of "green" enlisted and lieutenant replacements, and five of the battalion commanders were new to that task. Given the failure of the British crossing on his left flank, the division commander expected the assault – over an unfordable river, directly under enemy observation and defenses, and with exposed flanks – to fail.

The assault

The attack was to commence on January 20 at 2000 hours, 3 hours after sunset; this would allow 11 hours of darkness to establish a bridgehead and erect bridges. Since the trucks were unable to reach the river, the troops had to carry the boats for a full mile – far further than was practical. The noise of this slow and laborious approach, including the detonation of mines and trip flares laid by the Germans on the American side, alerted the enemy. As soon as the US artillery preparation began the German guns also opened fire, and continued when the American prep ceased. In the misty darkness mines and artillery caused the loss or straying of perhaps one-third of the troops before they even reached the river, and struggling through the deep mud tired them out.

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The 40–50 degree slope of the banks caused the boats launched bow-first to flood, and the troops had not been instructed to launch them sideways. Artillery and mortar fire, which had already punctured some of the inflatables during the approach march, sank or damaged many of the boats in the disjointed first wave of crossings. Some troops drowned, the near-freezing water debilitated others, and those who did get ashore ran into more minefields. After the first hour only a hundred troops had crossed. Ropes had been tied to the sterns of the boats to pull them back across the river once the troops had debarked, but the strong current swung them downstream and many were not recovered. The two-man inflatable reconnaissance boats were inadequate, and many more were punctured (it is worth noting that the troops were carrying their bayonets fixed).

After this disrupted and piecemeal crossing there was a 2-hour wait for more boats, and since there were no engineers at the boat depots to bring more forward it was infantrymen, who were needed in the assault, who had to carry them. Most of the bridging materials being moved forward were destroyed by artillery and mines; others were found to be defective, and even when they were assembled ice forming on the catwalks caused some troops to slip off. Under shellfire in the darkness and confusion on the near bank, infantrymen waited for engineers to bring more boats forward, engineers waited for the fire to lift so that they could erect footbridges, and engineer minefield guides never linked up. Another problem was the too heavy use of screening smoke, which disoriented the troops and blinded friendly observers.

A few boatloads of two companies of the 1/141st Infantry got across, and with immense effort three footbridges were kept intact long enough for other troops to join them. Most of the 1/143rd made it across and two footbridges were emplaced, but when morning came these were destroyed by shellfire, and counterattacks inflicted such high casualties that the battalion commander withdrew on his own initiative. The 3/143rd never made it, and crossings were halted at sunrise. The few men on the far shore were ordered to dig in, but found that they could dig down only 8in before the foxholes filled with water. Pinned down and receiving fire from three sides, some troops fled, and companies were down to two dozen effectives. By mid-morning on January 21, the German command was reporting that the US assault detachments had been annihilated.

General Keyes ordered Gen Walker to make a second assault at 1400 hours on the 21st, but the time it took to assemble just 50 each assault and pneumatic boats delayed this until 1600 hours. The 3/ and 2/143rd Infantry got men across at one site and the 1/143rd at another, while engineers worked frantically to emplace and maintain footbridges. The troops who made it across got pinned down in an enclave measuring only 200 yards deep by 600 yards wide, and the 1/143rd was reduced to 250 men by daybreak. Before nightfall on the 22nd, it was clear that the regiment's foothold was untenable, and the survivors were withdrawn.

To the north, part of 2/141st Infantry crossed from 2100 hours, and two footbridges survived just long enough to allow elements from 3/141st to follow; they dug in nearly 1,000 yards from the shore, but by daylight on January 22 the 141st, too, were completely isolated and under relentless fire. Out of the two regiments, only 700 men had made it across the river during the second night, and all efforts to construct Bailey bridges to get armor across in their support had failed under enemy shellfire.

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Soviet soldiers clamber aboard a couple of Lend-Lease amphibious jeeps (known in the US as the "seep," from the elision of "sea" and "jeep"). Produced only in 1943, these were also used by US forces, but proved suitable only for crossing calm, slow-flowing water. (Courtesy of the Central Museum of the Armed Forces, Moscow via Stavka)

At 0230 hours on the night of January 22/23 the 142nd Infantry assaulted, but with no time to prepare, few boats, and insufficient equipment the attempt was doomed. Further action was halted, and the troops were withdrawn after news arrived of the success of the Anzio landing; further diversions and losses would be futile. The Germans offered a 3-hour truce to gather casualties, but were ignored.

The Rapido crossing was an unmitigated disaster. The 36th Infantry Division and its attachments lost 1,330 dead, wounded, and missing, plus 770 taken prisoner, the great majority of these from among the 5,200-odd officers and men of the six infantry battalions committed. The division fought on until the end of the month, but then had to be withdrawn from the line and rebuilt. The 15. Panzergrenadier-Division had lost just 64 dead and 179 wounded.

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SELECT BIBLIOGRAPHY

Allen, Peter, *One More River: The Rhine Crossings of 1945* (New York; Charles Scribner's, 1980)

Beck, Arfred M.; Bortz, Abe; Lynch, Charles W.; & Weld, Ralph F., *United States Army in World War II, The Corps of Engineers: The War Against Germany* (Washington, DC; Center for Military History, 1985)

Beiersdorf, Horst, *Bridgebuilding Equipment of the Wehrmacht 1939–1945* (West Chester, PA; Schiffer Military History, 1998)

Blumenson, Martin, *Bloody River: The Real Tragedy of the Rapido* (College Station, TX; Texas A&M University Press, 1998)

Ford, Ken, *Cassino, The Four Battles January-May 1944* (Ramsbury, UK; Crowood Press, 2001)

Ford, Ken, *Assault Crossing: The River Seine 1944* (Barnsley, UK; Pen and Sword, 2011)

Forty, George, *British Army Handbook 1939–1945* (Stroud, UK; Sutton, 1998)

Harpur, Brian, *A Bridge to Victory: The Untold Story of the Bailey Bridge* (London; HMSO, 1991)

Hechler, Ken, *The Bridge at Remagen: A Story of World War II* (Novato, CA; Presidio, 2005)

Kugler, Randolf, *Chronik der Landungspioniere 1939–1945* (Speyer, Germany; Kameradschaft der Landungspioniere, 1987)

Kutta, Timothy, *DUKW in Action* (Carrollton, TX; Squadron/Signal Publications, 1997)

Liere, Otl, *Pioniere im Kampf* (Berlin; Wilhelm Limpert, 1940)

Nichols, Chester W., *Bridging for Victory* (Warrensburg, MO; privately published, 1977)

Pergrin, Col David E. & Hammel, Eric, *First Across the Rhine: The Story of the 291st Engineer Combat Battalion in France, Belgium, and Germany* (New York; Atheneum, 1989)

Radford, Albert E. & Redford, Laurie S., *Unbroken Line: The 51st Engineer Combat Battalion—From Normandy to Munich* (Woodside, CA; Cross Mountain Publishing, 2002)

Rawson, Andrew, *Rhine Crossing: Operations Plunder and Varsity* (Barnsley, UK; Leo Cooper, 2007)

Riebenstahl, Horst, *Deutsche Pioniere im Einsatz 1939–1945: Eine Chronik in Bildern* (Eggolsheim, Germany; Dörfler, 2001)

Schultz, Duane, *Crossing the Rapido: A Tragedy of World War II* (Yardley, PA; Westholme Publishing, 2010)

Scott, John L., *Combat Engineer* (re: 111th Combat Engr Bn – Baltimore, MD; American Liberty Press, 1999)

Sliz, John, *Engineer Assault Boats in Canadian Service* (Ottawa; Service Publications, 2006)

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Sliz, John, *Non-Bailey Bridging in Canadian Service* (Ottawa; Service Publications, 2010)
Smith, Lee C., *A River Swift and Deadly: The 36th "Texas" Infantry Division at the Rapido River* (Waco, TX; Eakin Press, 1997)
Southergill, Norman, *A Combat Engineer Remembers* (re: 150th Combat Engr Bn - Bloomington, IN; Trafford Publishing, 2006)
Wong, John B., *Battle Bridges* (Victoria, British Columbia; Trafford Publishing, 2006)
US Army, *Handbook on USSR Military Forces*, TM 30–430 (November 1946)
US Army, *Handbook on German Military Forces,* TM E-30–451 (March 1945)
US Army, *Stream Crossing Equipment*, Information Bulletin No. 120 (July 1943)

http://cgsc.cdmhost.com/cdm/singleitem/collection/p4013coll8/id/2854/rec/

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